MICROSTRATIGRAPHY OF THE CARBONATE MANGANESE ORE LAYERS OF THE SHAFT III. OF ÚRKÚT ON THE BASIS OF PALYNOLOGICAL INVESTIGATIONS

M. KEDVES and P. SIMONCSICS

Institute for Botany of the József Attila University, Szeged

INTRODUCTION

The first data about the pollens of the manganese ore of Úrkút were published by the authors previously (1961). In this work it was established, that the manganese ore as a sediment may contain sporomorphs, although the monstly oxy-ores are rather unsuitable for quantitative palynological evaluation. In the 47 samples first investigated only two samples were found suitable for quantitative evaluation and even these samples were argilliferous. Authors' attention was therefore turned to the carbonate ores when they prepared the diagram of the fundamental profil which is indispensable for the more detailed investigations with palynological methods. From the primary manganese ores of Úrkút, known from the work of CSEH—NÉMET (1958), the mother-lode of manganese ore of the shaft III. was investigated by the authors with positive results. All samples contained microresidues in a quantity which was sufficient for quantitative evaluation. In the followings this profil will be considered as a fundamental profil. Microscopical investigations results in a very rich material of spores, pollens and microplancton. The abundance of forms considerable surpasses the coenosis published in authors' previous work. Several new taxa, form-species, form-genera were described and also taxa of higher orders were initiated. These results are published here only fragmentary due to the limited space. The problems connected with the palynological microstratigraphy of the profil of the carbonate mother-lode will be discussed in detail.

MATERIAL AND METHODS

The profil of the manganese ores of the mother-lode of the shaft III. of Úrkút was investigated in full. Figure 1. shows adjoining the drawing of the fundamental profil the exact depth of the samples and the quantitative palynological data. In consequence of the continuity of sampling in the representation of the quantitative data the values were halved and were plotted in that way on the two sides of a central axis. The sequence of the taxonomically heterogenous sporomorpha-groups, drawn together in different grade, was determined according to the stratigraphical significance.

Method of the preparation of the material for microscopical investigations was the following:

About 100 g of the ore was breaked into little fragments in a porcelain mortar. The fragments between 0,5 and 0,25 mm were separated with the aid of sieving and 20 g from this fraction were measured in a beaker. Digestion was began with diluted hydrochloric acid till the sample became plastic. This require generally 5-10 hours or sometimes 3-4 days. The remaining acid and salts were decanted and washed out with distilled water. Thereafter the organic constituents separated from the minerals with the aid of $ZnCl_2$ (Zólyomi, 1952). The $ZnCl_2$ was washed out with distilled water. This washing must be performed with the greatest care; the quality of the preparates depends highly on this operation! The anorganic matter still remaining was removed with hydrofluoric acid. After washing, the material is suitable for microscopical examination, although the sporomorphs are extremly dark and the fine structures are not or only hardly to see. For clarifying of the spores and pollens salpetre acid and potassium hydroxide were used. Naturally, a very careful washing was performed after each of these treatments too. The centrifuged material was transferred in vials with glycerol-gelatinate containing glycerol. For the microscopie investigations glycerol-gelatinate preparates were made and 60× and 90× homogeneous immersion objectives were used. The photomicrographs were made with the same objectives and are published here unretouched.

NOMENCLATURE

Nomenclature of mesozoic sporomorphs is only a little elaborated as compared to that of the terciary ones. Present investigations of the authors made possible a more profound discussion of the spores and pollens of the Jurassic period. In connection with the nomenclature the heterogenous character of the trends must be emphasized. The most important trends are reviewed in the followings:

1. Erdtman (1948) used in the description of *Tricolpites (Eucommiidites) Troedssonii* Erdtman 1948 the trinomial nomenclature initiated by himself *(nomen typicum abstractum; nomen typicum concretum; nomen differentiale).*

2. Reissinger (1950) in his work made an effort to range the sporomorphs demonstrated by him among natural categories, e. g. he used the following designations: *„Meist Palmen-Pollen; Vielleicht cf. Larix; Podocarpaceen-Pollen; Equisetaceensporen; Vermutlich Taxodiaceenpollen; cf. Lycopodium inundatum; cf. Selaginella selaginelloides* Link" etc. In the case, when the exact determination met with difficulties, he used names of general characteristic (e. g. *„vermutlich Farnspore")*, or artificial names: e. g. *Pityosporites pallidus* Reiss. 1938 (=*Pityopollenites pallidus* Reissinger 1950), *cf. Pollenites hiatus* R. Pot., *Sporonites neddeni* R. Pot. Also Rogalska (1954) follows this trend, she made efforts for identifications with recent taxa.

3. Kara—Murza (1960) combines in his book three trends; he uses natural, semi-natural and artificial names. Examples. a) Natural names: *Bennettitales, Ginkgoales, Podocarpaceae, Cibotium polaris* K—M. b) Semi-natural names: *Piceites variabiliformis* (Mal.) (=*Orbicularia variabiliformis* Mal.), *Todites* sp. etc.) Artificial names: *Leiotriletes microdiscus* K—M. This threefold character

of nomenclature was defined in the works of Potonié, Thomson and Thiergart (1950) and Potonié (1952) in first line in the relation of the terciary sporomorphs. This method was applied by Bolkhovitina (1961) in the monography about *Schizaeaceae* spores and in her new work (Bolkhovitina [1962]), and by Korotkevich (1961), Kurnosova (1960), Malyavkina (1962), Markova (1962), Molin (1961), Romanovskaya (1962) and by other authors too.

4. The work of Couper (1958) was a landmark in the investigation of mesozoic spores and pollens. In his monography he prefers the semi-natural names. It is an interesting effort of his, according to which on the basis of the investigation of associated spores of several megafossilia he attempts to connect nomenclaturally the dispers and associated spores. e. g. he described the genus *Klukisporites* for the dispers spores which are morphologically similar to the spores which are known from the sporangia of the makrofossilium *Klukia.* He described the genus *Todisporites* which spores are similar to the spores of the *Todites* residues. This effort is modern and remarkable. The genera, however, which are properly described on the basis of the morphographic systems must be left out of consideration and so, according to the rule of priority, several new genera introduced by him became invalid. These discrepancies of Couper's work (1958) were demonstrated in connection with the genus *Klukisporites* by Stanley and Pocock (1962) too. According to the rule of priority the spores described by Couper in 1958 as *Klukisporites* belong to the genus *Dictyotriletes* (Naumova) Pot. and Kr. 1954.

5. The use of artificial systems manifest itself in the work of Lantz (1958), who applied the formal categories described in the fundamental works of Luber (1955), Balme (1957), Erdtman (1947), Delcourt and Sprumont (1955), Potonié and Gelletich (1933), Weyland and Krieger (1953), Weyland and Greifeld (1953), Potonié and Kremp (1954), Pflug (1952) and others. In addition he used semi-natural names too, in first line on the basis of the works of Couper (1953, 1958), Potonié (1951), Potonié and Venitz (1934) and Potonié, Thomson and Thiergart (1950).

This latter method suits for the most part authors' conception which will be reviewed later. First, however, some general problems of the nomenclature of mesozoic sporomorphs must be taken into consideration.

1. In contrast to the clear explanation of Rouse (1957), according to which it is extremely wrong and irregular to describe new species in recent genera on the basis of the morphology of fossil dispers spores and pollens, several authors act in this manner. It is regrettable that the clear and fundamental arguments of Rouse (1957) did not attain wide-ranging recognition. The essence of Rouse's theses are the followings:
of Rouse's theses are the followings:

a) The species-diagnosis of a recent plant is based on the properties of the sporophyton generation.

b) The gametophyton generation is in several cases aspecific.

2. Because the recens species are inseparable on the basis of spores and pollens, it is a just supposition that the „species" described on the basis of fossil sporomorphs in the reality include several extinct species. Therefore will be considered the „species" of *„Sporae dispersae"* as formal categories and the designations form-genus (fgen.) and form-species (fsp.) known from several works of Krutzsch will be used.

Taking into consideration that the efforts trended to the unification of the nomenclature of *Sporae dispersae* remained ineffective till now, and in the present situation a solution is not expected in the near future, authors' work does not raise a claim of the solution of the problem. They only outline their present point of view:

1. Authors do not accept taxa, which are irregularly described, including the „species" ranged into recens genera.
2. As a basis serve the artificial systems and the new species will be described and arranged into formal categories. From the point of view of the botany this is the most proper method, because the representants of the vegetation of the Mesophyticum are not to connect directly with the recens genera, especially not on the basis of their gametophyton generation.
3. Authors made an effort to detect the priority of each genera and according to this they emended the species arranged in other genera — as far as this was possible.
4. Before each category the list of the form-species reviewed in the followings is given, for easier to manage the work.
5. In the qualitative part of the results only a part of the spores will be treated according to the system of the work of KRUTZSCH (1959). Further results concerning the spores and the pollens and microplancton will be treated in a following work.

RESULTS

Sporites H. Potonié 1893

TRILETES REINSCH 1881
AZONOTRILETES LUBER 1935
LAEVIGATI (B. and K. 1868) R. POT. and KR. 1954

Fgen.: LEIOTRILETES (NAUMOVA 1937) R. POT. and KR. 1954

1. *L. manganicus* n. fsp. (Plate I, 1, 2)
2. *L. brevilaesuratus* n. fsp. (Plate I., 3, 4)
3. *L. urkutensis* n. fsp. (Plate I., 5, 6)
4. *L. sphagnoides* n. fsp. (Plate I., 7—10)
5. *L. transdanubicus* n. fsp. (Plate I., 11, 12)
6. *L. complicatus* (LESCHIK 1955) n. comb. (Plate I., 13, 14)
7. *L. globosus* (LESCHIK (1955) n. comb. (Plate II., 5, 6)
8. *L. pflugi* SIMONCSICS and KEDVES 1961 (Plate II., 1, 2)

L. pflugi SIMONCSICS and KEDVES 1961 fvar. *triplan* SIMONCSICS and KEDVES 1961 (Plate II., 3, 4)

1. *Leiotriletes manganicus* n. fsp. (Plate I., 1, 2)

Diagnosis:

Seen from the pole the contour is triangular, the angles are only slightly rounded off. The exosporium is triplex. The outer lamella is thinner than 1 μ. The middle lamella is about 2 μ on the angles, along the side lines thinner. The inner lamella is uniformly 0,5 μ thick. The laesures of the tetrad mark are rectilinear, at the ends slightly bifurcated and they reach the equator.

Maximal measurement: 42 μ.

Holotypus: Plate I., 1, 2, prep. U—III—2—36—1.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore mother-lode of the shaft III.

Stratum typicum: Dark-grey, finely streaked clayey marl with manganese content.

Derivatio nominis: from the name of the embedding rock of the holotypus.

Spores of similar morphology:

a) REISSINGER [1950]: *"Kleine Pteridophyten-, wahrscheinlich Farnsporen"* (plate 12, 8); Liassic period.
b) SAH [1955]: *Leiotriletes Type 9;* Salt Range West Punjab (Pakistan), Jurassic period.
c) KARA—MURZA [1960]: *Leiotriletes sp. (Coniopteris sp.?)* Spore of *Triquetrella trisecta* MAL. type. (Plate 12., 6), surroundings of Katangsk, Lower Callovian.

2. *Leiotriletes brevilaesuratus* n. fsp. (Plate I., 3, 4)

Diagnosis:

Seen from the pole the contour is triangular, the angles are widely rounded off. Width of exosporium is 1,8—2 μ, it is duplex, the layers are equally thick. The laesures are recti-linear and do not reach the equatorial contour, $r = {}^{2}/_{3} - {}^{4}/_{5}$. The surface is smooth or scabrat.

Maximal measurement: 42 μ.

Holotypus: Table I., 3, 4, prep. U—III—2—68—3.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore mother-lode of the shaft III.

Stratum typicum: Dark-grey, finely streaked clayey marl with manganese carbonate content.

Derivatio nominis: from the relatively short laesures.

Spore of similar morphology:

a) BOLKHOVITINA [1956]: *Adiantum mollis* BOLKHOVITINA; Yakutsk A. S. S. R., Kangalassy, Upper Jurassic period.

3. *Leiotriletes urkutensis* n. fsp. (Plate I., 5, 6).

Diagnosis:

Seen from the pole the contour is triangular with rounded off angles. The exosporium is rather thin, always below 1 μ. The surface is finely scabrat. The laesures of the tetrad mark are slightly wavy and they reach the equator.

Maximal measurement: 44 μ.

Holotypus: Table I., 5, 6, prep. U—III—4—27.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore mother-lode of the shaft III.

Stratum typicum: green, grey, finely streaked carbonate manganese ore.

Derivatio nominis: from Úrkút, the site of holotypus.

Spores of similar morphology:

a) MINER [1935]: *Deltoidospora cascadensis* MINER 1935; Lower Cretaceous.
b) BOLKHOVITINA [1953]: *Leiotriletes varius* BOLKHOVITINA 1953; Western Kazakhstan. Lower Cretaceous.
c) BOLKHOVITINA [1953]: *Hausmannia anonyma* BOLKHOVITINA 1953 (=*Leiotriletes anonymus* BOLKHOVITINA 1953); Moscow region Dimitrov district, Volguska River Settlement Paramonovo, Lower Cretaceous.

d) LESCHIK [1955]: *Laevigatisporites tenuis* LESCHIK 1955; Upper Triassic (Keuper stage).
e) SAH [1955]: *Leiotriletes Type 6* (Pl. 1, fig. 7); Salt Range West Punjab (Pakistan), Jurassic period. SAH [1955] compared the spore observed by him with the followings: *Coniopteris hymenophylloides* BRONG., *Thyrsopteris elegans* KZE., *Eboracia lobifolia* — THOMAS 1911 — *Cladophlepis (Eboracia) lobifolia* — SZE 1933—.
f) COUPER [1958]: *Coniopteris hymenophylloides* (BRONGNT.) (Plate 20., 5); Middle Jurassic period.
g) ROUSE [1959]: *Deltoidospora psilostoma* ROUSE 1959; Kootenay (British Columbia), Upper Jurassic period.
h) KARA—MURZA [1960]: *Coniopteris sp.* (Plate 3, 3); surroundings of Katangsk, Middle Triassic period (Ladinian?).
i) KURNOSOVA [1960]: *Coniopteris sp.* (Plate 2, 6); surroundings of Krasnoyarsk, Lower Jurassic period.
j) KURNOSOVA [1960]: *Coniopteris sp.* (Plate 5, 9); surroundings of Krasnoyarsk, Upper Jurassic period.

4. *Leiotriletes sphagnoides* n. fsp. (Plate I., 7—10).

Diagnosis:

Seen from the pole the contour is triangular with rounded off angles. The sides are almost straight, locally a slightly concave, sometimes a little convex. Exosporium is about 1,5 μ thick, duplex. The thickness of the ectexosporium and endexosporium is about the same. The surface is smooth or slightly scabrat. The laesures of the tetrand mark are long, but they reach only rarely the equator, $r = {}^{2}/_{3}$—${}^{5}/_{5}$.

Maximal measurement: 30 μ.

Holotypus: Plate I., 7, 8, prep. U—III—6—1., 3,5/69,5.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore motherlode of the shaft III.

Stratum typicum: green, grey, finely streaked carbonate manganese ore.

Derivatio nominis: from several similarities with the spores of Sphagnaceae.

Spores of similar morphology:

a) MINER [1935]: *Deltoidospora hallii* MINER 1935; Lower Cretaceous period.
b) BOLKHOVITINA [1953]: *Leiotriletes varius* BOLKHOVITINA 1953; Lower and Middle Albian stage.
c) KARA—MURZA [1960]: *Stenozonotriletes gracilis* K.—M.—; surroundings of Katangsk, Middle Liassic period.
d) KARA—MURZA [1960]: *Coniopteris cf. onychioides* VAS. et K.—M.; surroundings of Katangsk, Aptian stage.

Plate I.

1, 2. — *Leiotriletes manganicus* n. fsp. (U—III—2—36—1)
3, 4. — *Leiotriletes brevilaesuratus* n. fsp. (U—III—2—68—3)
5, 6. — *Leiotriletes urkutensis* n. fsp. (U—III—4—27)
7, 8. — *Leitriletes sphagnoides* n. fsp. (U—III—6—1, 3, 5/69, 5)
9, 10. — *Leiotriletes sphangnoides* n. fsp. (U—III—3—76—2)
11, 12. — *Leiotriletes transdanubicus* n. fsp. (U—III—3—1, 16/81)
13, 14. — *Leiotriletes complicatus* (LESCHIK 1955)n. comb.
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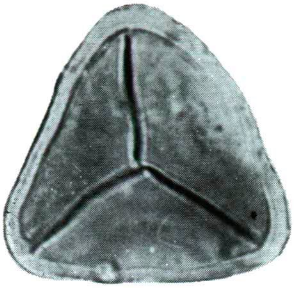
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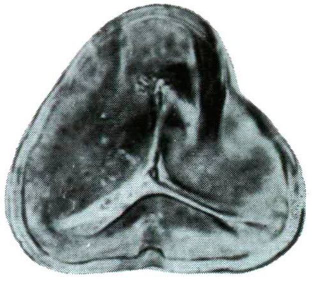
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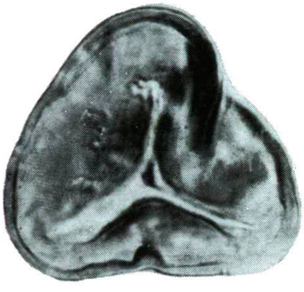
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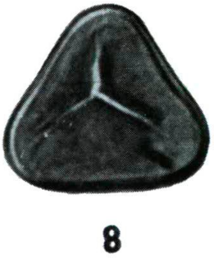
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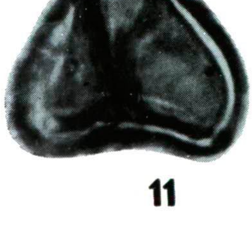
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e) KURNOSOVA [1960]: *Gleichenia sp.* (Plate 4, 1, 1/a); surroundings of Krasnoyarsk, Middle Jurassic period.
f) KURNOSOVA [1960]: *Thyrsopteris pyramidalis* K.—M.; surroundings of Krasnoyarsk, Middle Jurassic period.

5. *Leiotriletes transdanubicus* n. fsp. (Plate I., 11, 12).

Diagnosis:

Seen from the pole the contour is triangular, the angles are only slinghtly rounded off. The side lines are slightly convex or concave. The exosporium is 2—2,5 μ thick, double-layered, the ectexosporium and the endexosporium are equally thick. The surface is smooth. The laesures almost reach the equator, $r = 4/5$.

Maximal measurement: 33 μ.

Holotypus: Plate I. 11, 12, prep. U—III—3—1, 16/81.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore motherlode of the shaft III.

Stratum typicum: Green, grey, finely streaked carbonate manganese ore.

Derivatio nominis: from the site of the holotype, Transdanubia.

Notes. — It occured in very great quantity, especially in the lower third part of the layer. It is interesting that the exemplares observed were in triplaniod situation without exception.

6. *Leiotriletes complicatus* (LESCHIK 1955) n. comb. (Plate I., 13, 14).

Syn.: 1955 — LESCHIK, *Laevigatisporites complicatus* LESCHIK.

Seen from the pole the contour is triangular with rounded off angles. The exosporium is 0,8—1,3 μ thick. The ectexosporium and the endexosporium are equally thick. Sometimes the latter is thicker. The ectexosporium is smooth, the endexosporium is chagrenat of finely punctat. The laesures are long, but do not always reach the peaks of the spore.

Maximal measurement: according to LESCHIK (1955) 33$\times$17 μ, the exemplares of Úrkút are about 31 μ.

Notes: The form-species was described from the Keuper by its author and as botanical connection he designs *?Calamariaceae*. It is interesting, that the typical spores and the spores known from the manganese ore, are equally „pseudotriplan" forms.

Spore of similar morphology:

a) KARA—MURZA [1960]: *Equisetites rotundus* (NAUM.) (*=Leiotriletes rotundus* NAUM.); surroundings of Katangsk, Middle Triassic period (Anizian).

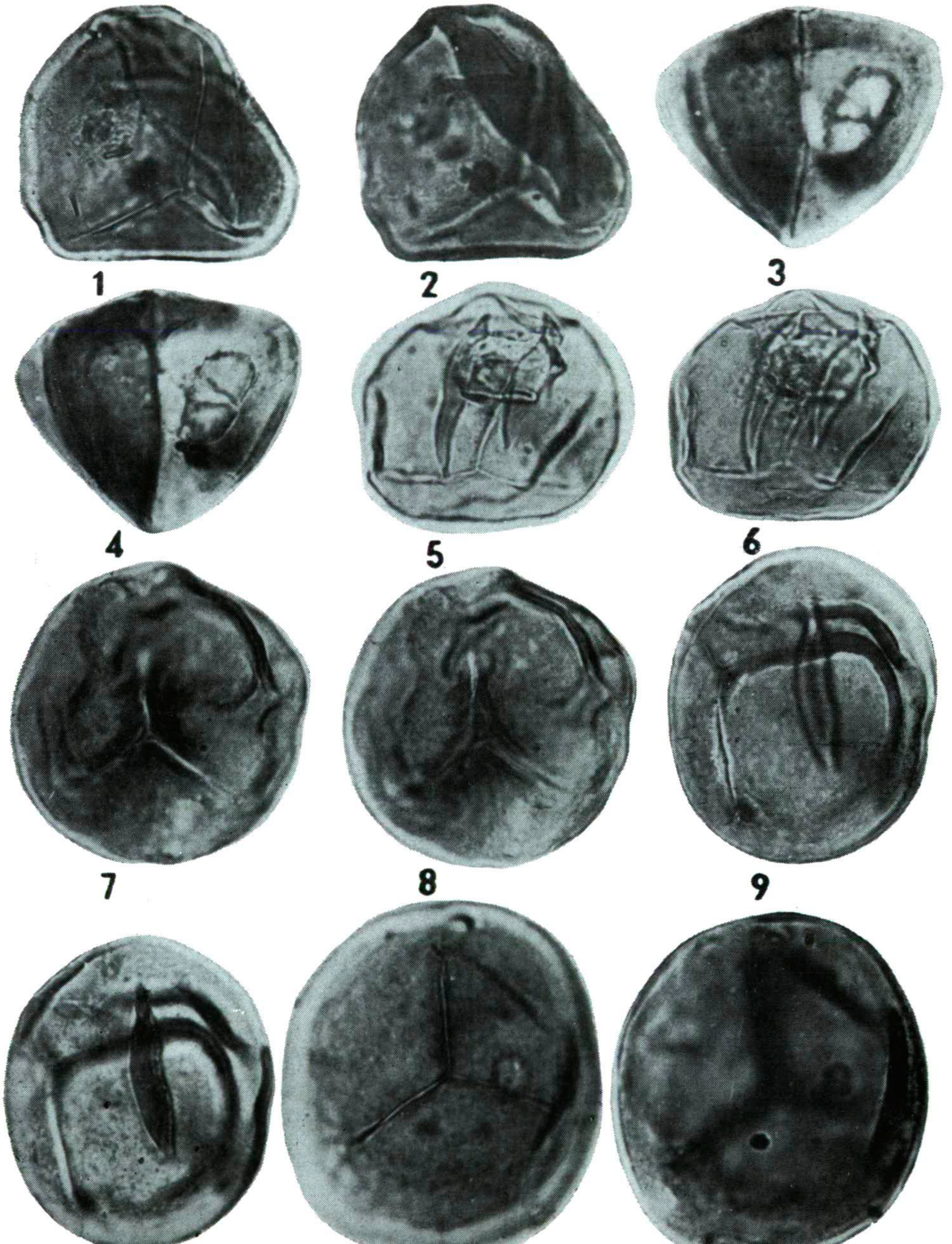
7. *Leiotriletes globosus* (LESCHIK 1955) n. comb. (Plate II., 5, 6).

Syn.: 1955 — LESCHIK, *Laevigatisporites globosus* LESCHIK.

Seen from the pole, the contour is triangular with considerable rounded off angles, or circular. The exosporium is thin, about 1μ, the surface is smooth,

Plate II.

1, 2. — *Leiotriletes pflugi* SIMONCSICS & KEDVES 1961 (U—III—2—51—3)
3, 4. — *Leiotriletes pflugi* SIMONCSICS & KEDVES 1961 fvar. *triplan* SIMONCSICS & KEDVES 1961 (U—III—6—28)
5, 6. — *Leiotriletes globosus* (LESCHIK 1955) n. comb. (U—III—35—1)
7, 8. — *Punctatisporites krutzschi* n. fsp. (U—III—25—94—3)
9, 10. — *Punctatisporites goczani* n. fsp. (U—III—2—51—2)
11, 12. — *Punctatisporites goczani* n. fsp. (U—III—20—118)
1000$\times$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the endexosporium is finely punctat. The laesures are long, generally they reach the equatorial contour, $r = {}^4/_5 - {}^5/_5$.

Maximal measurement: according to LESCHIK [1955] 33—37 μ, the exemplares of Úrkút are about 36 μ.

Together with the above mentioned form — species also this one was found first from Keuper layers.

8. *Leiotriletes pflugi* SIMONCSICS and KEDVES 1961. (Plate II., 1, 2).
Leiotriletes pflugi SIMONCSICS and KEDVES 1961 fvar. *triplan* SIMONCSICS and KEDVES 1961 (Plate II., 3, 4).

In the course of author's investigations occured this spores in great quantity especially from the third layer of the profil.

Fgen: PUNCTATISPORITES IBRAHIM 1933

1. *P. krutzschi* n. fsp. (Plate II., 7, 8)
2. *P. goczani* n. fsp. (Plate II., 9—12)
3. *P. circulus* n. fsp. (Plate III., 5—8)
4. *P. major* (COUPER 1958) n. comb. fvar. *pseudotriplan* n. fvar. (Plate III., 1, 2)
5. *P. parvigranulosus* LESCHIK 1955 (Plate III., 3, 4)

1. *Punctatisporites krutzschi* n. fsp. (Plate II., 7, 8)

Diagnosis:

Seen from the pole the contour is circular. The thickness of exosporium is always less than 1 μ. The ectexosporium and the endexosporium have the same measure. The structure is finely punctat. Ornamental elements are equally distributed, except the region of the laesures where they are located more densely in a stripe of about 3 μ. The laesures of the tetrad mark are short and do not do not reach the equatorial contour. $r = {}^1/_2 - {}^3/_4$.

Maximal measurement: 43 μ.

Holotypus: Plate II., 7, 8, prep. U—III—25—94—3.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore motherlode of the shaft III.

Stratum typicum: Rhodochrozit containing grey manganese ore powdered with pyrit.

Derivatio nominis: from DR. W. KRUTZSCH, the excellent investigator of fossile sporomorphs.

Notes. — The thin exosporium of the new form-species described is generally wrinkled. This and the relatively short laesures remind of *Calamospora* S. W. and B. 1944 and of *Monoleiotriletes* KRUTZSCH 1959 in younger sediments. The characteristic structure of the exosporium definitely delineates it from the other genera mentioned.

Spores of similar morphology:

a) BOLKHOVITINA [1956]: *Leiotriletes glaber* (NAUMOVA 1938) WALTZ 1941 var. *mesozoicus* BOLKHOVITINA 1956; Yakutsk District and Kangalassy. Upper Jurassic period.

2. *Punctatisporites goczani* n. fsp. (Plate II., 9—12).

Diagnosis:

Seen from the pole the contour is circular or ellipsoid. The exosporium is about 0,8—1,2 μ thick. The ectexosporium is a little thicker, than the endexosporium. The surface of the spore is very densely punctat, covered with ornamented elements. The laesures of the tetrad mark are straight, generaly they do not reach the equatorial contour, $r = ^4/_5$, exceptionally $^5/_5$.

Maximal measurement: 48 μ.

Holotypus: Plate II., 11, 12, prep. U—III—20—118.

Isotypus: Plate II., 9, 10, prep. U—III—2—51—2.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore motherlode of the shaft III.

Stratum typicum: Brown, redbrown, locally roughly streaked manganese ore.

Derivatio nominis: from Dr. F. GÓCZÁN, the excellent investigator of the Hungarian mesozoic sporomorphs.

Spores of similar morphology:

a) WEYLAND and GREIFELD [1953]: *Punctatisporites rotundus* WEYLAND and GREIFELD 1955; Quedlinburg, Harz, Upper Cretaceous, 1. Senon.
b) LESCHIK [1955]: *Punctatisporites ambiguus* LESCHIK 1955; Upper Triassic period, Middle Keuper stage.
c) SAAD [1963]: *Leiotriletes sp. Type A* (Plate 33, 4); Euone Moussa district, West of Sinai, Middle Jurassic period, particularly Bajocian stage.

3. *Punctatisporites circulus* n. fsp. (Plate III., 5—8)

Diagnosis:

Seen from the pole the contour is circular or triangular with considerable rounded off angles. The thickness of the exosporium is less than 1 μ, generally it is about 0,8 μ. The ectexosporium is somewhat thicker than the endexosporium. The surface is punctat, locally finely scabrat. Along the equator the ornamental elements are radially located. The laesures of the tetrad mark are straight or slightly waved and generally they reach the equator, $r = ^4/_5$—$^5/_5$.

Maximal measurement: 37 μ.

Holotypus: Plate III., 5, 6, prep. U—III—2—1, 14, 5/96, 2.

Isotypus: Plate III., 7. 8.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore motherlode of the shaft III.

Stratum typicum: Dark-grey, finely streaked clayey marl with manganese carbonate content.

Derivatio nominis: from its characteristic contour.

4. *Punctatisporites major* (COUPER 1958) n. comb. fvar. *pseudotriplan* n, fvar. (Plate III., 1, 2.)

Syn.: 1958 — COUPER, *Todisporites major* COUPER.

COUPER [1958] arranged the dispers spores similar to the spores prepared from the macrofossilia *Todites williamsonii* and *Todites princeps* into the genus *Todisporites* COUPER 1958. His establishments about the surface of the spores according to which this surface is smooth or finely scabrat are not wholly acceptable, regarding the published figures. One part of the spores arranged into the form-genus *Todisporites* COUPER 1958 may be arranged without any difficulty into the form-genus *Punctatisporites* IBRAHIM 1933. So the genus *Todisporites* COUPER 1958 may be partly considered as the synonime of *Punctatisporites* IBRAHIM 1933. The spores of similar type with smooth surface belong literally to *Leiotriletes* (NAUMOVA 1937) R. POT and KR. 1954.

The exemplares observed in the manganese ore were pseudotriplan without exeption. The thickness of the exosporium were about 1,—1,5 μ. The ectexosporium is somewhat thicker than the endexosporium. The surface is finely punctat, locally scabrat.

5. *Punctatisporites parvigranulosus* LESCHIK (Plate III., 3, 4)

The contour is circular or secondary deformed ellipsoid or triangular with rounded off angles. The exosporium is single-layered, about 1 μ. The surface is punctat. The laesures of the tetrad mark are straight but they do not reach the equator. $r = {}^3/_4 - {}^4/_5$.

Maximal measurement: 60 μ.

The measures of the exemplares found in the manganese ore are somewhat larger than the exemplares observed by LESCHIK [1955]. This only quantitative differences give no reason for exclusion the forms observed by us from LESCHIK's [1955] form-species. As botanical connections for this form KRÄUSEL and LESCHIK [1955] mentioned the *Dipteridaceae* or the *Matoniaceae*. These forms were described first from layers of the Keuper stage.

Fgen.: SPHAGNUMSPORITES RAATZ 1937.

1. *Sp. psilatus* (ROSS) COUPER 1958 (Plate III., 9, 10)
2. *Sp. clavus* (BALME) DE JERSEY 1959 (Plate III., 11—14)

1. *Sphagnumsporites psilatus* (ROSS) COUPER 1958 (Plate III., 9, 10)

Seen from the pole the contours are triangular with rounded off angles. The exosporium is double-layered. The thickness of the ectexosporium and the endexosporium is the same. The laesures of the tetrad mark reach nearly the equatorial contour, $r = {}^3/_4 - {}^4/_5$. The surface is wavely ornamented consisting of slightly emerged verrucae-like elements.

The maximal measure of the exemplares observed is about 30 μ. According to COUPER [1958] the form-species is frequent in Jurassic and Lower Cretaceous layers.

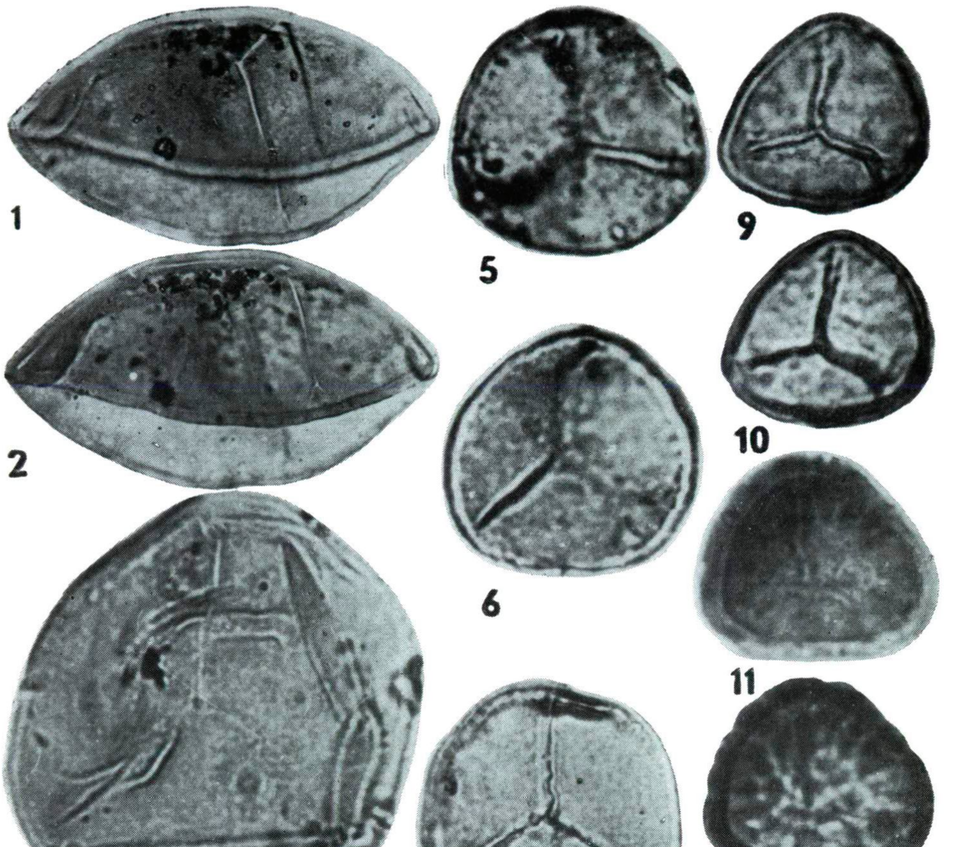
2. *Sphagnumsporites clavus* (BALME) DE JERSEY 1959 (Plate III., 11—14)

Maximal measurement occured in our material is 28—39 μ. The laesures of the tetrad mark are long, sometimes they reach the equator. The thickness of exosporium is about 2 μ. The ectexosporium is thicker, than the endexosporium. The surface is ornamented with large and flat elements.

Plate III.

1, 2. — *Punctatisporites major* (COUPER 1958) n. comb. fvar. *pseudotriplan* n. fvar. (U—III—47)
3, 4. — *Punctatisporites parvigranulosus* LESCHIK 1955 (U—III—3—1, 17, 5/77, 5)
5, 6. — *Punctatisporites circulus* n. fsp. (U—III—2—1, 14, 5/96, 2)
7, 8. — *Punctatisporites circulus* n. fps.
9, 10. — *Sphagnumsporites psilatus* (ROSS) COUPER 1958.
11, 12. — *Sphagnumsporites clavus* (BALME) DE JERSEY 1959.
13, 14. — *Sphagnumsporites clavus* (BALME) DE JERSEY 1959.
1000×

Plate III.



TRIPLANES (Pf. 1953) KRUTZSCH 1959.
Fgen.: TRIPLANOSPORITES PF. 1952 emend. TH. and PF. 1953.

1. *Tr. couperi* n. fsp. (Plate IV., 1)
2. *Tr. goczani* n. fsp. (Plate IV., 2, 3)
3. *Tr. manganicus* n. fsp. (Plate IV., 4)

Notes. — In connection with this form-genus it must be emphasized, that all form-species must be considered as provisoric ones due to their „triplan" characteristic. This characteristic is only a state of maintenance of the trilete spores (cf. H. DEÁK [1959], KEDVES [1961]).

The trilet form of the three form-species described below are not yet known. If in the course of subsequent investigations the original trilet forms will be discovered, than these forms must be naturally rearranged as the triplan form varieties of the trilet forms.

1. *Triplanosporites couperi* n. fsp. (Plate IV., 1)

Diagnosis:

The equatorial contour is considerably concave, the length of the polar axis is about 52 μ and is about the same as that of the equator. The thickness of the exosporium is 1—1,3 μ. The exosporium is double layered. The ectexosporium and the endexosporium have the same thickness. The surface is smooth or finely scabrat.

Holotypus: Plate IV., 1, prep. U—III—3—69—1.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore motherlode of the shaft III.

Stratum typicum: Green, grey finely streaked manganese ore with carbonate content.

Derivatio nominis: from. Dr. R. A. COUPER, the excellent investigator of the British mesozoic spores and pollens.

2. *Triplanosporites goczani* n. fsp. (Plate IV., 2, 3)

Diagnosis:

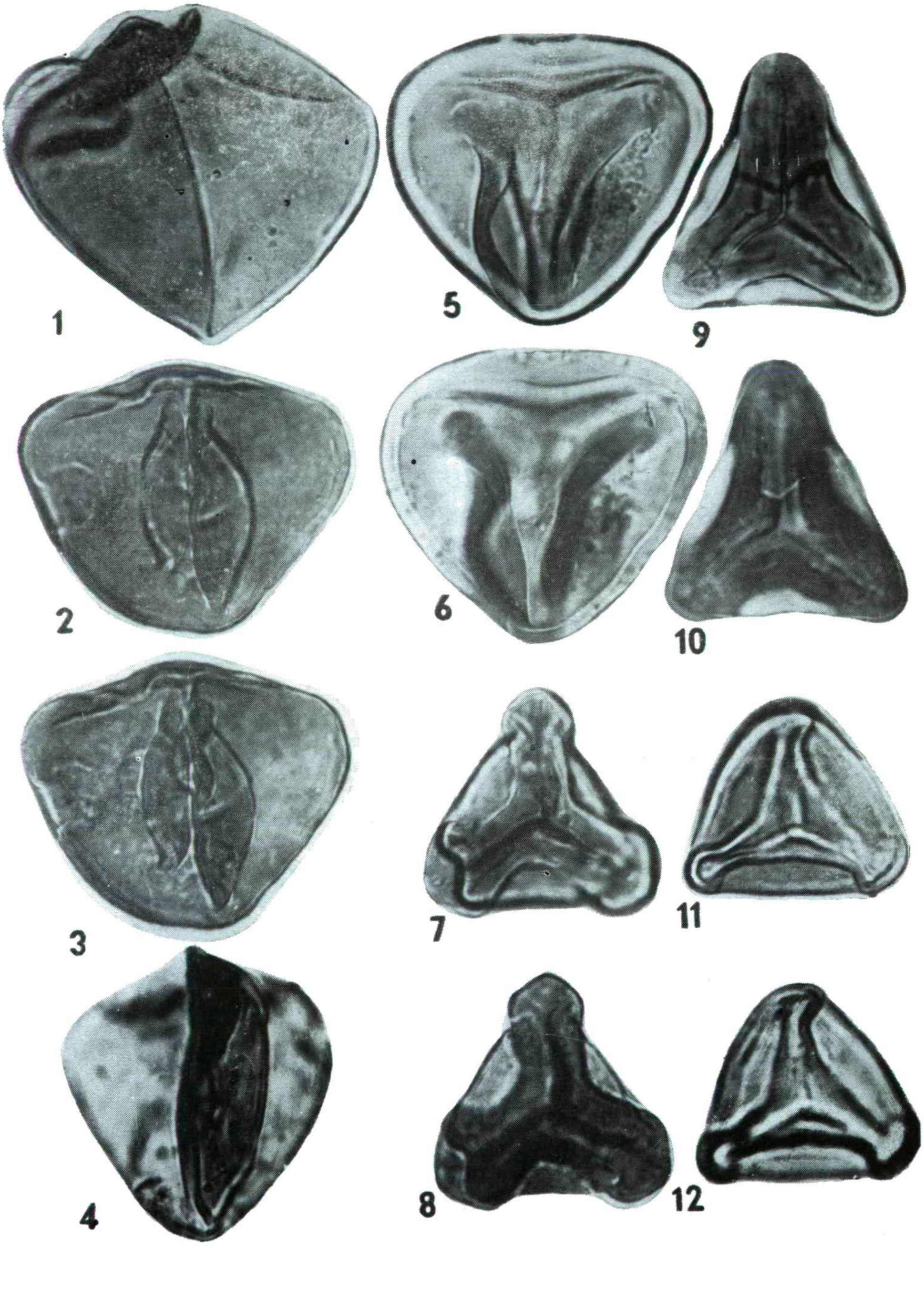
The equatorial contour is considerable concave. The polar axis is shorter than the equatorial one. (polar axis 39 μ, equatorial axis 48 μ). The thickness of exosporium is 1,8—2 μ, it is double layered. The ectexosporium and the endexosporium have the same thickness. The structure is scabrat or intrapunctat.

Holotypus: Plate IV., 2, 3, prep. U—III—2—1—1.

Locus typicus: Úrkút, manganese mine, carbonate manganese mother lode of the shaft III.

Plate IV.

1. — *Triplanosporites couperi* n. fsp. (U—III—3—69—1)
2, 3. — *Triplanosporites goczani* n. fsp. (U—III—2—1—1)
4. — *Triplanisporites manganicus* n. fsp. (U—III—2—1—2)
5, 6. — *Toroisporis (Toroisporis) crassiexinus* n. fsp. (U—III—2—62—1)
7, 8. — *Toroisporis (Toroisporis) crassitorus* n. fsp. (U—III—2—124—1)
9, 10. — *Toroisporis (Toroisporis) toralis* (LESCHIK 1955) n. comb. (U—III—3—82)
11, 12. — *Toroisporis (Toroisporis) macrosinus* n. fsp. (U—III—4—1, 17/74, 5)
1000×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12

Stratum typicum: Dark-grey, finely streaked clayey marl with manganese carbonate content.

Derivatio nominis: from Dr. F. GÓCZÁN the excellent investigator of the Hungarian mesozoic spores and pollens.

Spores of similar morphology:

a) GÓCZÁN [1956] *„Fernspore type 4/d";* Komló, Liassic carboniferous layers.

3. *Triplanosporites manganicus* n. fsp. (Plate IV., 4)

Diagnosis:

The equatorial contour is considerable concave. The length of the equatorial axis is less than the polar one. (polar axis: 44 μ, equatorial axis: 39 μ). The thickness of exosporium are generally 0,8 μ and it does not reach the 1 μ. The ectexosporium and the endexosporium have the similar thickness. The surface is smooth or finely scabrat.

Holotypus: Plate IV., 4, prep. U—III—2—1—2.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore motherlode of the shaft III.

Stratum typicum: Dark-grey, finely streaked clayey marl with manganese carbonate content.

Derivatio nominis: from the site of the holotype.

Spores of similar morphology:

a) REISSINGER [1950]: *„Vermutlich Farnsporen"* (Table 12. 14—16); Liassic period.
b) KARA—MURZA [1960]: *Leiotriletes sp.* (Plate 15, 18); surroundings of Katangsk, Lower Cretaceous — Aptian or Albian stage (?).

TORIATI KRUTZSCH 1959

Fgen.: TOROISPORIS KRUTZSCH 1959

Subfgen: TOROISPORIS (TOROISPORIS KRUTZSCH 1959)

1. *T. (Toroisporis) crassiexinus* n. fsp. (Plate IV., 5, 6)
2. *T. (Torosporis) crassitorus* n. fsp. (Plate IV., 7, 8)
3. *T. (Toroisporis) toralis* (LESCHIK 1955) n. comb. (Plate IV., 9, 10)
4. *T. (Toroisporis) macrosinus* n. fsp. (Plate IV., 11, 12)
5. *T. (Toroisporis) rectitorus* n. fsp. (Plate V., 1, 2)
6. *T. (Toroisporis) curvitorus* n. fsp. (Plate V., 3—6)
7. *T. (Toroisporis) hungaricus* n. fsp. (Plate VI., 1—4)
8. *T. (Toroisporis) reissingeri* n. fsp. (Plate VI., 5, 6)

1. *Toroisporis (Toroisporis) crassiexinus n. fsp.* (Plate VI., 5, 6)

Diagnosis:

Seen from the pole the contour is triangular with rounded off angles. The exosporium is 2,5—3,2 μ thick, the ectexosporium is much thicker than the endexosporium. The surface is scabrat or intrapunctat. The laesures of the tetrad mark are relatively long, but they do not reach the equator. Close to the laesures on both sides at about 1,5—2 μ width the exosporium is more thickened. The torus follows the direction of laesures.

Maximal measurement: 48 μ.

Holotypus: Plate IV., 5, 6, prep. U—III—2—62—1.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore mother-lode of the shaft III.

Stratum typicum: Dark-grey, finely streaked clayey marl with carbonate content.

Derivatio nominis: from the thick exosporium.

Notes: — The above mentioned fsp. is similar to, or perhaps identical with the spore published by GÓCZÁN [1956] from the carboniferous Liassic layers of Komló on his Plate 3., figure 11, named „*Páfrányspóra 4/c*".

2. *Toroisporis (Toroisporis) crassitorus* n. fsp. (Plate IV., 7, 8)

Diagnosis:

Seen from the pole the contour is definitely triangular the angles are only rounded off slightly. The torus protrudes from the spore, its width is 4—6 μ (measured from the laesure). Toward the poles it is enlarged or bifurcated. The thickness of the exosporium is about 1 μ, it is double-layered. The thickness of the ectexosporium and the endexosporium is the same. The surface is smooth or scabrat. The laesures of the tetrad mark are long, they reach the equator.

Maximal measurement: 38 μ.

Holotypus: Plate IV., 7, 8, prep. U—III—2—124—1.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore mother-lode of the shaft III.

Stratum typicum: Dark-grey, finely streaked clayey marl with manganese carbonate content.

Derivatio nominis: from the well-developped torus.

Spore of similar morphology:

a) SAAD [1963]: *Concavisporites Type C* (=*C. rugulatus* PFLUG or *Auritulinasporites scanius* NILSSON); Euone Moussa district, West Sinai, Middle Jurassic period, particularly Bajocian stage.

3. *Torisporis (Toroisporis) toralis* (LESCHIK 1955) n. comb. (Plate IV., 9, 10)

Syn.: 1955 — LESCHIK, *Laevigatisporites toralis* LESCHIK.

The contour is definitely triangular, the angles are only slightly rounded off. The exosporium is thin, it is less than 1 μ., it is on the angles somewhat thicker than along the sides. The surface is smooth or scabrat. The laesures are long, but they do not reach the equator, r=$^4/_5$. The torus is exceedingly robust, its width is 9—10 μ.

Maximal measurement: 42 μ.

Spores of similar morphology:

a) REISSINGER [1950]: *Sporonites neddeni* R. POT. (Plate 12, 4); Liassic period.
b) BOLKHOVITINA [1956]: *Phlebopteris exornatus* BOLKHOVITINA 1956; Yakutsk A. S. S. R. Sinyaya River, Lower Jurassic period.
c) GÓCZÁN [1956]:*Clathropteris sp.* (6 Type) (Plate 5. 8—12) carboniferous Liassic layers of Komló. GÓCZÁN compared this spores with the spores obtained by WLADIMIROVICH [1950] with the aid of maceration from the sorus-containing leaf-debris of *Clathropteris obovata var. magna* Tur.—Ket.
d) KOROTKEVICH [1961]: *Matonia triassica* K.—M.; U. S. S. R., Arctic region, Lower and Middle Tirassic period.

Notes. — In connection with the botanical relations LESCHIK [1955] mentioned the similarity of the spores of *Cyathea brunonis* WALL., and *Alsophila procera* KAULF.

4. *Toroisporis (Toroisporis) macrosinus* n. fsp. (Plate IV., 11, 12)

Diagnosis:

Seen from the pole the contour is definitely triangular. The exosporium is double-layered, the layers have the same thickness, the wall is 1,5 μ thick. The surface is scabrat. The laesures of the tetrad mark reach almost the equatorial contour. On the proximale side the torus is largely protruding and beside the laesures curved and forms large sinus on the angles. The width of the torus is 5—8 μ, the sinuous torus on the angles is 4—12 μ in diameter.

Maximal measurement: 30 μ.

Holotypus: Plate IV., 11, 12, prep. U—III—4—1, 17/74, 5.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore motherlode of the shaft III.

Stratum typicum: Green, grey, finely streaked manganese ore with carbonate content.

Derivatio nominis: from the characteristic sinuous form of the torus.

5. *Toroisporis (Toroisporis) rectitorus* n. fsp. (Plate V., 1, 2)

Diagnosis:

Seen from the pole the contour is triangular with rounded off angles and with straight or slightly convex slide lines. From the proximal side the torus is clearly visible, toward the side lines it is delineated with straight or slightly convex lines. The width of the torus is 8—12 μ measured from the proximale peak. The laesures of the tetrad mark are lang, they reach or almost reach the equatorial contour. The wall of the spores on the angles is 2,5—3 μ, along the side lines 1,5 μ, thick, it is double-layered, the inner and the outer parts have about the same thickness. The surface is smooth or slightly scabrat.

Maximal measurement: 58 μ.

Holotypus: Plate V., 1, 2, prep. U—III—1—91—2.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore motherlode of the shaft III.

Stratum typicum: Dark-grey, finely streaked clayey marl with manganese carbonate content.

Derivatio nominis: from the characteristic form of the torus.

Spore of similar morphology:

a) GÓCZÁN [1956]: *Phlebopteris münsteri* (SCHENK) HIRM. et HOER. (Type 4), Plate 2., 13); carboniferous Liassic layers of Komló.

6. *Toroisporis (Toroisporis) curvitorus* n. fsp. (Plate V., 3—6)

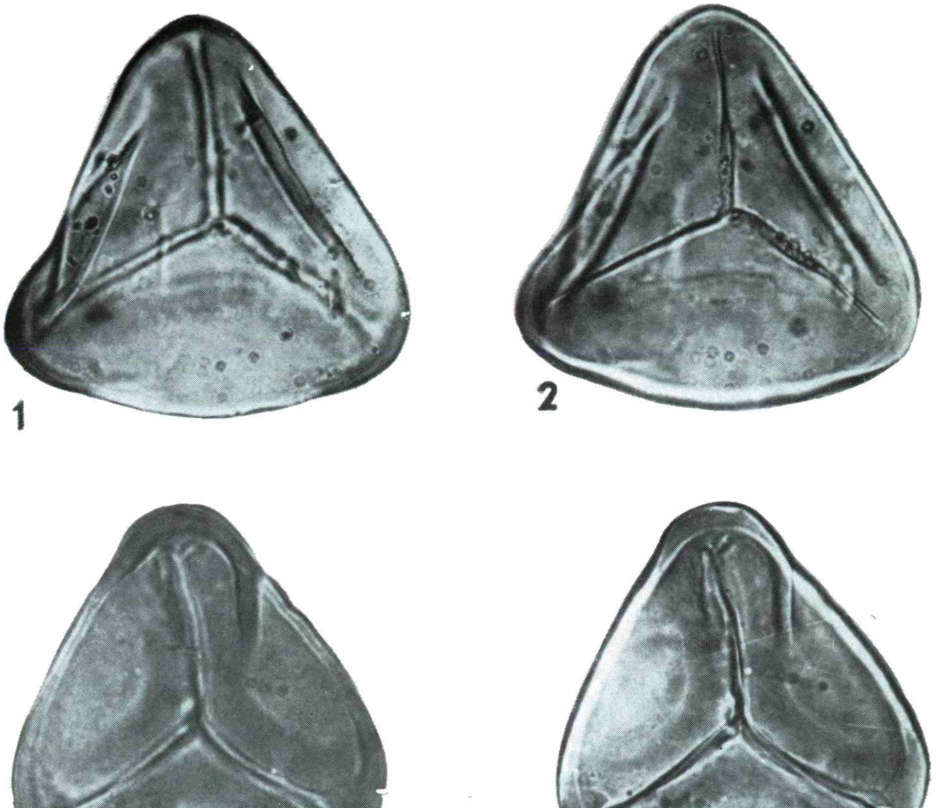
Diagnosis:

Seen from the pole the contour is triangular with rounded off angles. The angles are rounded or slightly angular. The side lines are straight. The torus is parallel with the laesures of the trilet mark and not with the side-lines. It avoids curved the laesures at the peaks. The width of the torus is 7—9 μ. The laesures are straight, they generally reach the peaks and they are at the end

Plate V.

1, 2. — *Toroisporis (Toroisporis) rectitorus* n. fsp. (U—III—1—91—2)
3—6. — *Toroisporis (Toroisporis) curvitorus* n. fsp. (U—III—2—121—4)
1000×

Plate V.



sometimes a little bifurcated. The exosporium has at the angles about a double thickness than at the sides. The exosporium is triplex. The two outer walls are less than 1 μ, the middle wall is 2 μ thick at the angles. The thickness of the side lines is 2 μ or less than 2 μ. The surface is smooth or scabrat.

Maximal measurement: 56 μ.

Holotypus: Plate V., 3—6, prep. U—III—2—121—4.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore mother-lode of the shaft III.

Stratum typicum: Dark-grey, finely streaked clayey marl with manganese carbonate content.

Derivatio nominis: from the form of the torus.

Spores of similar morphology:

a) REISSINGER [1950]: Plate 12., 7; Liassic period.
b) SAH [1953]: Plate 1., 2; Ceylon, Jurassic period.
c) SAH [1955]: *Leiotriletes Type 2* (Plate 1., 3, 4); Salt Range West Punjab (Pakistan), Jurassic period.
d) KARA—MURZA [1960]: *Matonia (?) triassica* K.—M. (Plate 1., 7, 8) surroundings of Katangsk, Triassic period (Ladinian?) stage.
e) SAAD [1963]: *Concavisporites sp. Type B (Gleicheniidites senonicus* Ross 1949 or *Clathropteris sp.* GÓCZÁN [1956]; Euone Moussa district, West of Sinai, Middle Jurassic period, particularly Bajocian stage.

7. *Toroisporis (Toroisporis) hungaricus* n. fsp. (Plate VI., 1—4)

Diagnosis:

Seen from the pole the contour is a triangle with rounded off angles and with convex or seldom slightly concave sides. The thickness of exosporium is 1,8—2,3 μ, it is double layered. The ectexosporium is thicker than the endexosporium. The surface is finely scabrat or intrapunctat. The laesures of the tetrad mark are straight, they almost reach the equatorial contour, $r = {}^4/_5$. The torus is delineated with regularly curved lines, average width is 5 μ.

Maximal measurement: 35 μ.

Holotypus: Plate VI., 1—4, prep. U—III—20—123—1.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore mother-lode of the shaft III.

Stratum typicum: Brown, redbrown, locally roughly streaked manganese ore with carbonate content.

Derivatio nominis: from Hungary, the site of holotype.

8. *Toroisporis (Toroisporis) reissingeri* n. fsp. (Plate VI., 5, 6)

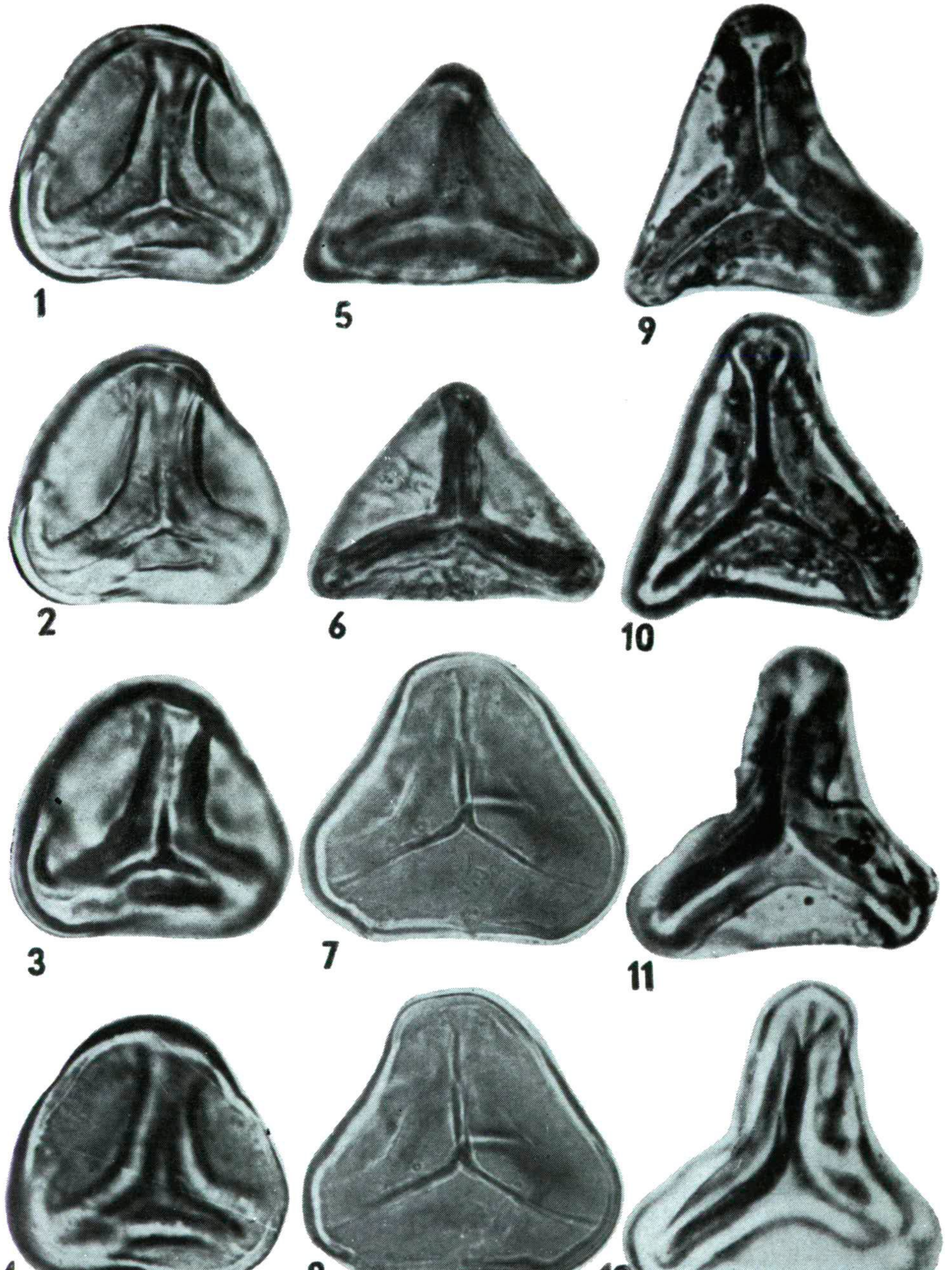
Diagnosis:

Seen from the pole the contour is a regular triangle, the sides are straight, the angles are only slightly rounded off. The exosporium is 2—2,8 μ thick,

Plate VI.

1—4. — *Toroisporis (Toroisporis) hungaricus* n. fsp. (U—III—20—123—1)
5, 6. — *Toroisporis (Toroisporis) reissingeri* n. fsp. (U—III—1—1)
7, 8. — *Concavisporites (Concavisporites) polygonalis* n. fsp. (U—III—2—64—1)
9, 10. — *Concavisporites (Concavisporites) mortoni* (DE JERSEY 1959) DE JERSEY 1962 (U—III—1—1, 16, 5/99)
11, 12. — *Concavisporites (Concavisporites) mortoni* (DE JERSEY 1959) DE JERSEY 1962. 1000×

Plate VI.



double layered. The thickness of ectexosporium and endexosporium is the same. The surface is smooth or finely scabrat. The laesures of the tetrad mark are long and always reach the equatorial contour. The torus surrounding the laesures is well developped, but it is relatively thin, generally 3 μ thick.

Maximal measurement: 42 μ.

Holotypus: Plate VI., 5, 6, prep. U—III—1—1.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore mother-lode of the shaft III.

Stratum typicum: Dark-grey, finely streaked clayey marl with manganese carbonate content.

Derivatio nominis: from Dr. A. REISSINGER, the pioneer of the palynology of the Liassic period.

Fgen.: CONCAVISPORITES PF. 1953
Subfgen.: CONCAVISPORITES (CONCAVISPORITES)

1. C. *(Concavisporites) polygonalis* n. fsp. (Plate VI., 7, 8)
2. C. *(Concavisporites) mortoni* (DE JERSEY 1959) DE JERSEY 1962 (Plate VI., 9—12)

1. *Concavisporites (Concavisporites) polygonalis* n. fsp. (Plate VI., 7, 8)

Diagnosis:

Seen from the pole the contour is concave, the angles of the spores are rounded off. The exosporium is double layered, at the angles it is a little thicker than at the sides. At the angles the thickness is 2 μ and at the sides 1—1,5 μ. The suface is smooth or very finely scabrat. The laesures of the tetrad mark reach the peaks. The laesures are accompanied by a well discernible torus.

Maximal measurement: 45 μ.

Holotypus: Plate VI., 7, 8, prep. U—III—2—64—1.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore- mother-lode of the shaft III.

Stratum typicum: Dark-grey, finely streaked clayey marl with manganese carbonate content.

Derivatio nominis: from the form of the spore.

Spore of similar morphology:

a) KURNOSOVA [1960]: *Lygodium subsimplex* (NAUM.) BOLCH. (Plate 5, 6); surroundings of Krasnoyarks, Upper Jurassic period.

2. *Concavisporites (Concavisporites) mortoni* (DE JERSEY 1959) DE JERSEY 1962 (Plate VI., 9—12)

Spores with concave contour, with characteristically well-developped torus. Maximal measurement of the exemplares observed is about 50 μ. The surface of exosporium is smooth or finely scabrat, it is about 1 μ thick. The ectexosporium and the endexosporium have the same thickness. The laesures of the tetrad mark are long, but do not reach always the equatorial contour.

Notes. — The figures about the spores of this form species published by DR. DE JERSEY [1959, 1962] may rise the suggestion that there are here heterogenous forms drawn together into a single category. The exemplares found by us in the manganese ore belong undoubtedly to this form group. This group may be perhaps divided in the future. This revision exceeds the task of this work.

Subfgen.: CONCAVISPORITES (OBTUSISPORIS KRUTZSCH 1959)

1. *C. (Obtusisporis) mesozoicus* n. fsp. (Plate VII., 1, 2)
2. *C. (Obtusisporis) reductus* n. fsp. (Plate VII., 3, 4)
3. *C. (Obtusisporis) undulus* n. fsp. (Plate VII., 5—7)
4. *C. (Obtusisporis) kara—murzae* n. fsp. (Plate VII., 8—9)
5. *C. (Obtusisporis) divisitorus* n. fsp. (Plate VII., 10, 11)
6. *C. (Obtusisporis) hexagonalis* n. fsp. (Plate VII., 12—14)

Notes: — The spores enumerated below belong to this form genus.

a) REISSINGER [1950]: *„Kleine Pteridophyten-, wahrscheinlich Farnsporen"* (Plate 12., 6); Liassic period.
b) GÓCZÁN [1956]: *„Páfrányspóra (cf. Concavisporites montis brassicae* THIERGART) *(type 7)"* (Plate 6., 1—5); carboniferous Liassic period, surroundings of Komló.
c) MOLIN [1961]: *Cibotium junctum* K.—M.; Konin, Jurassic period.
d) SAAD [1963]: *Concavisporites sp. Type E* (probably = *C. sinuatus* (COUPER 1953) KRUTZSCH 1959, = *C. jurienensis* BALME 1957, = *C. montis* THIERGART 1949, = *Triletes sinuatus* COUPER 1953, = *Cibotium junctum* KARA—MURZA, = *Auritulinasporites intrastriatus* NILSSON 1958); Euone district, West of Sinai, Middle Jurassic period, particularly Bajocian stage.

1. *Concavisporites (Obtusisporis) mesozoicus* n. fsp. (Plate VII., 1, 2)

Diagnosis:

Seen from the pole the contour is a concave triangle with slightly pointed angles. The thickness of exosporium is generally 2 μ, at the peaks 2,5 μ, in the middle of the concave slide lines 1,5 μ. The surface is smooth. The laesures of the tetrad mark reach the equator, sometimes they are bifurcated next to the equator. The „obtusi apparatus" is well developped. It has along the laesures torus like emergences.

Maximal measurement: 43 μ.

Holotypus: Plate VII., 1, 2, prep. U—III—5—86—2.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore motherlode of the shaft III.

Stratum typicum: Green, grey finely streaked manganese ore with carbonate content.

Derivatio nominis: from the age of its site.

2. *Concavisporites (Obtusisporis) reductus* n. fsp. (Plate VII., 3, 4)

Diagnosis:

Seen from the pole the contour is very concave with rounded off angles. The surface is smooth, „obtusi apparatus" is reduced, the laesures are slightly wavy, they reach the equator. The thickness of the exosporium ot the peak of the spore is more than 1 μ and at the sides below 1 μ.

Maximal measurement: 43 μ.

Holotypus: Plate VII., 3, 4, prep. U—III—2—71.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore mother-lode of the shaft III.

Stratum typicum: Dark-grey, finely streaked clayey marl with manganese carbonate content.

Derivatio nominis: from the reduced „obtusi apparatus".

3. *Concavisporites (Obtusisporis) undulus* n. fsp. (Plate VII., 5—7).

Diagnosis:

Seen from the pole the contour is a concave triangle with rounded off angles. The „obtusi apparatus" is slightly developped. Near to the proximal pole the laesures are very wavy. The end of the laesures is straight and it reaches the equator. The sculpture is scabrat. The thickness of the exosporium is 1,5 μ, at the peaks and at the sides equally.

Maximal measurement: 35 μ.

Holotypus: Plate VII., prep. U—III—3—75.

Locus typicus: Úrkút, manganese mine, shaft III. carbonate manganese ore mother-lode.

Stratum typicum: Green, grey, finely streaked manganese ore with carbonate content.

Derivatio nominis: from the wavy laesures.

Spore of similar morphology:

a) KURNOSOVA [1960]: *Cibotium junctum* K.—M.: surroundings of Krasnoyarks. Middle Jurassic period.

4. *Concavisporites (Obtusisporis) kara—murzae* n. fsp. (Plate VII., 8, 9)

Diagnosis:

Seen from the pole the contour is slightly concave. The peaks of the spore are strongly rounded off. The laesures are long but do not reach the peaks of the spore. Between the laesures the exosporium is protruding. The „obtusi apparatus" is strongly developped. The walls are smooth or slightly scabrat with 1,5—2 μ thickness.

Maximal measurement: 30 μ.

Holotypus: Plate VII., 8, 9, prep. U—III—20—2.

Locus typicus: Úrkút, manganese mine, shaft III. carbonate manganese ore mother-lode.

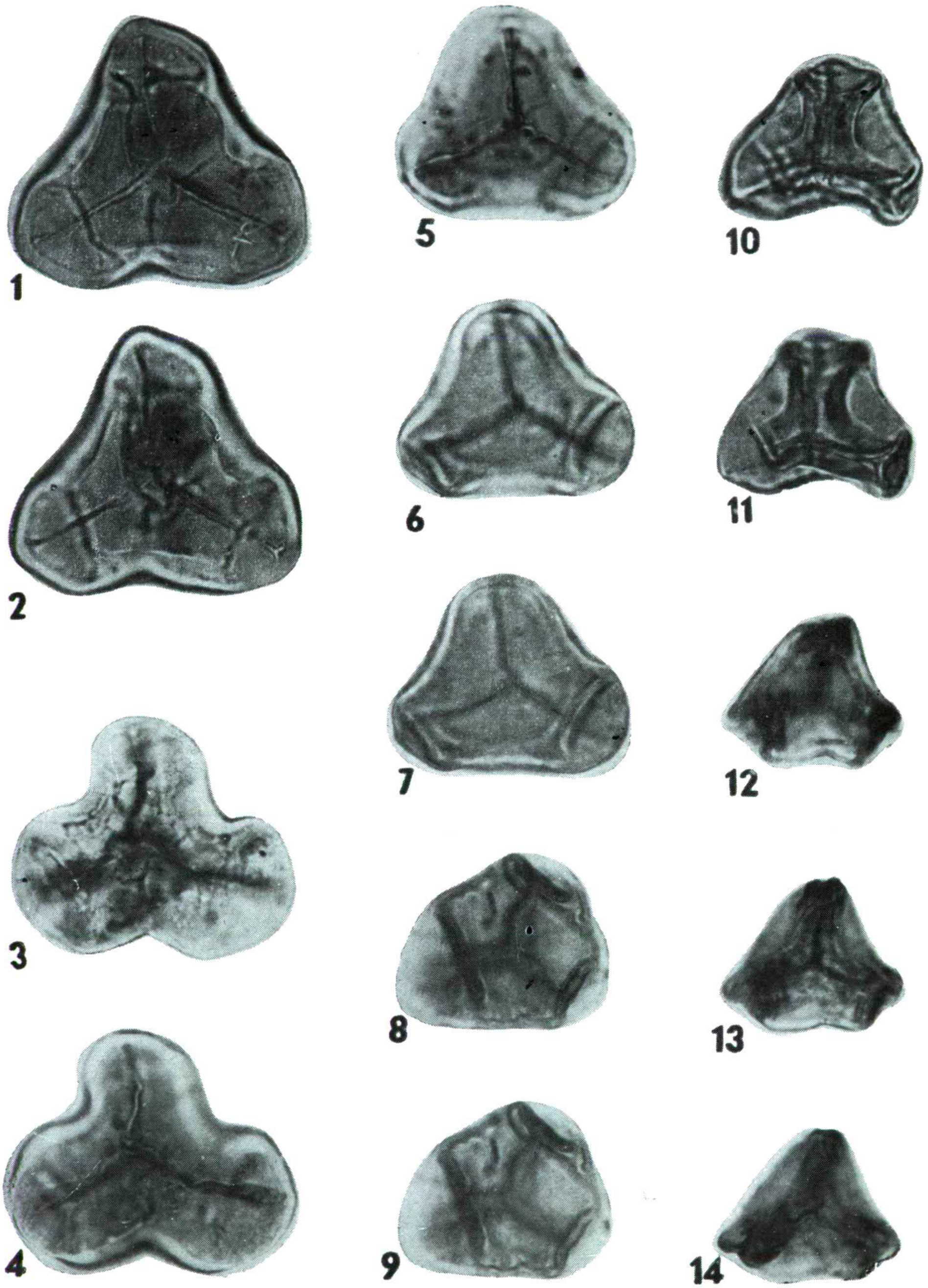
Stratum typicum: Brown, reddish brown, locally roughly streaked manganese ore with carbonate content.

Derivatio nominis: from DR. KARA—MURZA, the excellent investigator of mesozoic sporomorphs.

Plate VII.

1, 2. — *Concavisporites (Obtusisporis) mesozoicus* n. fsp. (U—III—5—86—2)
3, 4. — *Concavisporites (Obtusisporis) reductus* n. fsp. (U—III—2—71)
5—7. — *Concavisporites (Obtusisporis) undulus* n. fsp. (U—III—3—75)
8, 9. — *Concavisporites (Obtusisporis) kara—murzae* n. fsp. (U—III—20—2)
10, 11. — *Concavisporites (Obtusisporis) divisitorus* n. fsp. (U—III—20—1)
12—14. — *Concavisporites (Obtusisporis) hexagonalis* n. fsp. (U—III—25—94—2)
1000×

Plate VII.



Spores of similar morphology:

a) KARA—MURZA [1960]: *Cibotium junctum* K.—M. surroundings of Katangsk, Middle Jurassic period.

b) KURNOSOVA [1960]: *Cibotium corniculatum* BOLCH.; surroundings of Krasnoyarsk, Hauterivian—Barremian.

5. *Concavisporites (Obtusisporis) divisitorus* n. fsp. (Plate VII., 10, 11)

Diagnosis:

Seen from the pole the contour is slightly concave. The peaks of the spore are slightly pointed out. The laesures reach the equator and here and there they are bifurcated. „Obtusi apparatus'' is well developped, between the laesures there is a strong torus, that is 3 μ, maximum 4 μ wide. The torus is bifurcated toward the peaks of the spore. The exosporium is thin, it is always less than 1 μ. The surface is smooth or finely scabrat.

Maximal measurement: 28 μ.

Holotypus: Plate VII., 10, 11, prep. U—III—8—20—1.

Locus typicus: Úrkút, manganese mine, shaft III. carbonate manganese ore mother-lode.

Stratum typicum: Brown, light brown, finely streaked manganese ore with carbonate content.

Derivatio nominis: from the torus bifurcated towards the peaks of the spore.

6. *Concavisporites (Obtusisporis) hexagonalis* n. fsp. (Plate VII., 12—14)

Diagnosis:

Seen from the pole the contour is a concave hexagon. The laesures reach the equator. They are strongly wavy with a well developped torus. The width of the torus is 2—3 μ. The torus is enlarged towards the peaks and it is slightly bifurcated. The exosporium is smooth, near the torus scabrat or intrapunctat. The exosporium is thin, the thickness is always less than 1 μ.

Maximal measurement: 26 μ.

Holotypus: Plate VII., 12—14, prep. U—III—25—94—2.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore mother-lode of the shaft III.

Stratum typicum: Grey, carbonate manganese ore with dispersed pyrite and rhodochrosite content.

Derivatio nominis: from its charcteristic contour.

Spore of similar morphology:

a) KURNOSOVA [1960]: *Cibotium paradoxum* (MAL.) K.—M.; surroundings of Krasnoyarks, Lower Jurassic period.

APICULATI (B. and K.) R. POT. and. KR. 1954
Fgen.: VERRUCOSISPORITES IBRAHIM 1933

1. *V. rarus* n. fsp. (Plate VIII., 1, 2)

1. *Verrucosisporites rarus* n. fsp. (Plate VIII., 1, 2)

Diagnosis:

Seen from the pole the contour is triangular with rounded off angles and concave sides. The thickness of exosporiu mis about 1 μ, the ectexosporium and the endexosporium have the same thickness. The surface is covered with uniformly and sparsely dispersed ornaments. This ornaments are about 0,5 μ high, their basis seen from above has a diameter of about 1 μ. The laesures of the tetrad mark do not reach the equator, $r = {}^3/_4 - {}^4/_5$.

Maximal measurement: 25 μ.

Holotypus: Plate VIII., 1, 2, prep. U—III—13—1, 5, 5/66, 5.

Locus typicus: Úrkút, manganese mine carbonate manganese ore motherlode of the shaft III.

Stratum typicum: Brown, light brown, finely streaked manganese ore with carbonate content.

Derivatio nominis: from the sparsely verrucated exosporium.

Spores of similar morphology:

a) BOLKHOVITINA [1956]: *Dennstaedtiites confrarugosus* BOLKHOVITINA 1956; surrounding of Yakutsk A. S. S. R. Sinyaya River, Lower Jurassic period.

b) KURNOSOVA [1960]: *Trachytriletes* NAUM. (Plate 5., 13); surroundings of Krasnoyarks, Upper Jurassic period.

Fgen.: BACULATISPORITES THOMSON and PFLUG 1953.

1. *B. spinifer* — (Thiergart 1949) n. comb. (Plate VIII., 3, 4)

1. *Baculatisporites spinifer* (THIERGART 1949) n. comb. (Plate VIII., 3, 4)

Syn.: 1949 — THIERGART, *Sporites spinifer* THIERGART.

The contour is circular or secondary elliptic. The thickness of the exosporium is about 1 μ. The ectexosporium is ornamented with various baculat, gemmat or echinat elements. The measure of the ornaments is about 1 μ. The laesures of the tetrad mark are long but do not reach the contour of the equator, $r = {}^3/_4 - {}^4/_5$. The measure of the observed forms is about 27 μ.

Spore of similar morphology:

a) LESCHIK [1955]: *Apiculatisporites spininger* LESCHIK 1955; Upper Triassic period, Middle Keuper stage.

Notes. — The spore described by LESCHIK [1955] is only echinat ornamented and it is larger than the spores mentioned by us.

MURORNATI R. POT. and KR. 1954

Fgen.: TRILITES COOKSON 1947 ex COUPER 1953.

1. *T. pulcher* n. fsp. (Plate VIII., 5, 6)
2. *T. couperi* n. fsp. (Plate VIII., 7—9)

1. *Trilites pulcher* n. fsp. (Plate VIII., 5, 6)

Diagnosis:

Seen from the pole the contour is triangular with rounded off angles or nearly circular. The exosporium is 2,5—3 μ thick. The ectexosporium is much thicker than the endexosporium. The laesures of the proximal side reach almost the equatorial contour. R is generally ${}^4/_5$. The ornaments of the proximale pole consists of flat blurred verrucae, which are not, or only slightly observable along the tetrad mark. The average measure of the ornamental elements is about 4 μ. The distale pole is densely ornamented with well developped elements. The verrucae are frequently pointed and they form frequently rugulat ornaments by fusion. On the latter ornamental elements appear further granulated ornaments sparsely. Diameter of the granules is alweys less than 1 μ.

Maximal measurement: 32 μ.

Holotypus: Plate VIII., 5, 6, prep. U—III—2—1, 16, 5/96.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore mother-lode of the shaft III.

Stratum typicum: Dark grey, finely streaked clayey marl with manganese carbonate content.

Derivatio nominis: from its various ornaments.

2. *Trilites couperi* n. fsp. (Plate VIII., 7—9)

Diagnosis:

Seen from the pole the contour is a triangle with rounded off angles. The exosporium is 3—3,5 μ thick. The ectexosporium is thicker than the end-exosporium. At the proximale pole the laesures of the tetrad mark reach or almost reach the equatorial contour, $r = {}^4/_5 - {}^5/_5$. The ornaments at the proximale pole are rugulat or hamulat, sometimes verrucat. The ornamental elements are always less than 1 μ. The structure is not characteristic. The ornamental elements on the distale pole and along the equator are always more high than 1 μ. The ornamental elements are mostly verrucae or rarely other ornamental elements.

Maximal measurement: 52 μ.

Holotypus: Plate VIII., 7—9, prep. U—III—6—30.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore mother-lode of the shaft III.

Stratum typicum: Green, grey finely streaked manganese ore with carbonate content.

Derivatio nominis: from Dr. A. R. Couper, the excellent investigator of the British mesozoic spores and pollens.

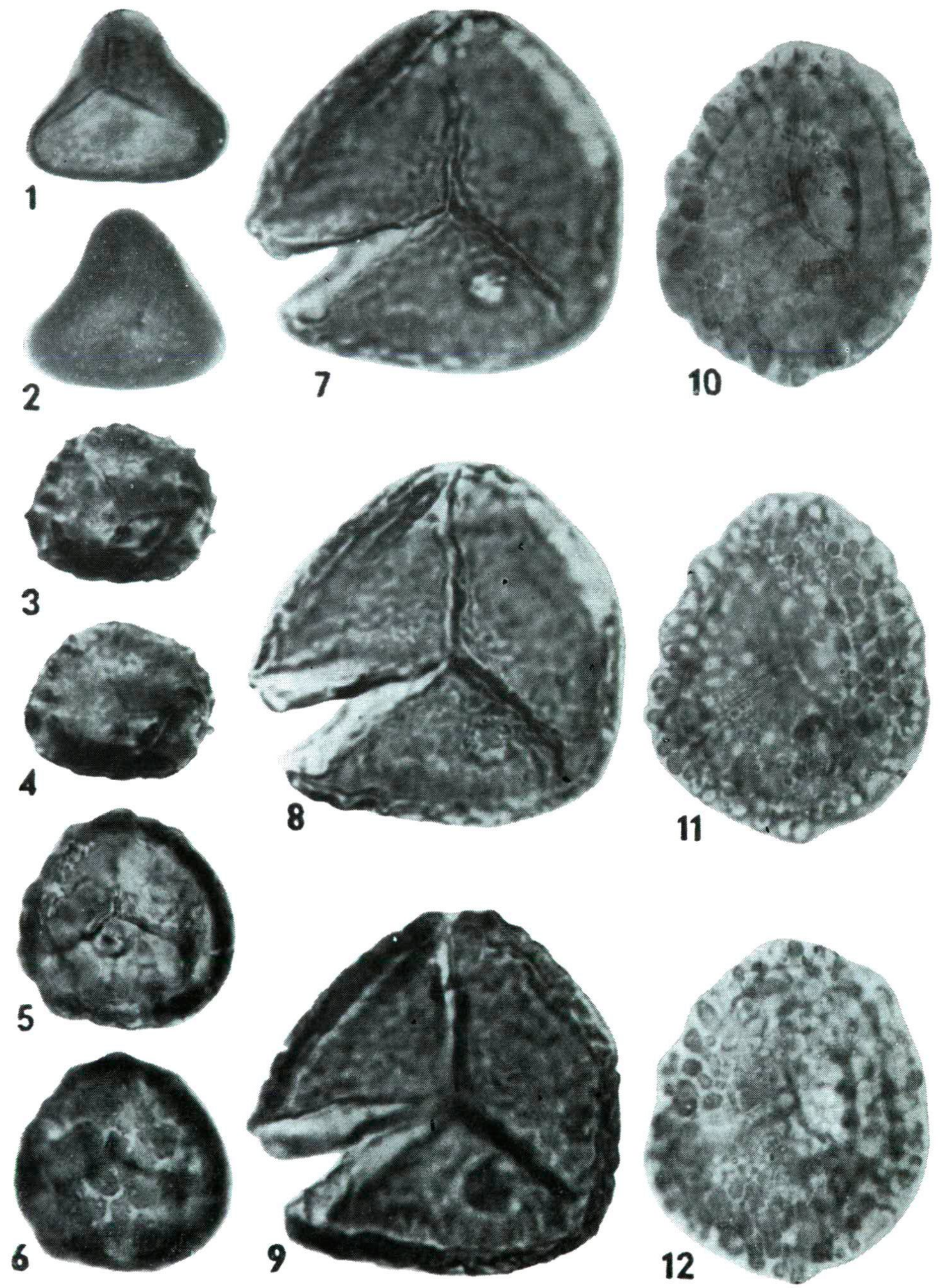
Fgen.: CLAVATISPORITES n. fgen.
Fgen. typus: *Cl. clarus* n. fsp.

1. *Cl. clarus* n. fsp. (Plate VIII., 10—12)
2. *Cl. platycapitulus* n. fsp. (Plate IX., 1—4)
3. *Cl. pulcher* n. fsp. (Plate IX., 5, 6)
4. *Cl. microcapitulus* n. fsp. (Plate IX., 7—9)
5. *Cl. minor* n. fsp. (Plate IX., 10, 11)
6. *Cl.* fsp. (Plate IX., 12)

Fgen.: *Clavatisporites* n. fgen.
Fgen. typus: *Clavatisporites clarus* n. fsp. (Plate VIII., 10—12).

Plate VIII.

1, 2. — *Verrucosisporites rarus* n. fsp. (U—III—13—1, 5, 5/66, 5)
3, 4. — *Baculatisporites spinifer* (Thiergart 1949) n. comb. (U—III—2—1, 14,5/96,2)
5, 6. — *Trilites pulcher* n. fsp. (U—III—2—1, 16, 5/96)
7—9. — *Trilites couperi* n. fsp. (U—III—6—30)
10—12. — *Clavatisporites clarus* n. fgen. et fsp. (U—III—3—1)
1000×


1
2
3
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5
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12

Diagnosis:

Azonotrilet microspores. The sculpture of exosporium is uniformly clavat.

Notes. — It may be well distinguished by the uniformly clavat sculpture from the spores of similar morphology.

The spores enumerated below belong probably to this form genus:

a) KARA—MURZA [1960]: *Selaginella rotundiformis* K.—M.; surroundings of Katangsk, Middle Jurassic period.
b) KURNOSOVA [1960]: *Selaginella fibula* KURNOSOVA 1960 (Plate 7, 2); surroundings of Krasnoyarsk, Cenomanian—Turonian stage.
c) STANLEY and POCOCK [1962]: *Lycopodiumsporites gristhorpensis* COUPER 1958, Western Canada Plains, Jurassic—Creatceous period.

1. *Clavatisporites clarus* n. fsp. (Plate VIII., 10—12)

Diagnosis:

Seen from the pole the contour is a triangle with rounded off angles, sometimes it is elliptic or nearly circular. The exosporium is thin, less than 1 μ. The clavat ornamental elements densely cover the surface of the spore at the proximale pole, except next to the laesures. The measure of the ornamental elements is larger at the distale pole than at the proximale one. Their height is 4—6 μ, diameter of the head is 1—5 μ, mostly 3 μ. The shaft is 1—1,5 μ long. The laesures reach the equator.

Maximal measurement: 50 μ.

Holotypus: Plate VIII., 10—12, prep. U—III—3—1.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore mother-lode of the shaft III.

Stratum typicum: Green, grey, finely streaked manganese ore with carbonate content.

Derivatio nominis: from the light exine of the holotype.

2. *Clavatisporites platycapitulus* n. fsp. Plate IX., 1—4)

Diagnosis:

Seen from the pole the contour is almost circular. The exosporium is thin, at most 1 μ thick. The laesures are long, thin and they reach the equator. The clavae are generally 4 μ long, the heads are of different measures: 2—7 μ. At the proximale side the ornamental elements are more sparse, at the distale side they are dense and the heads of the clavae are larger.

Maximal measurement: 36 μ.

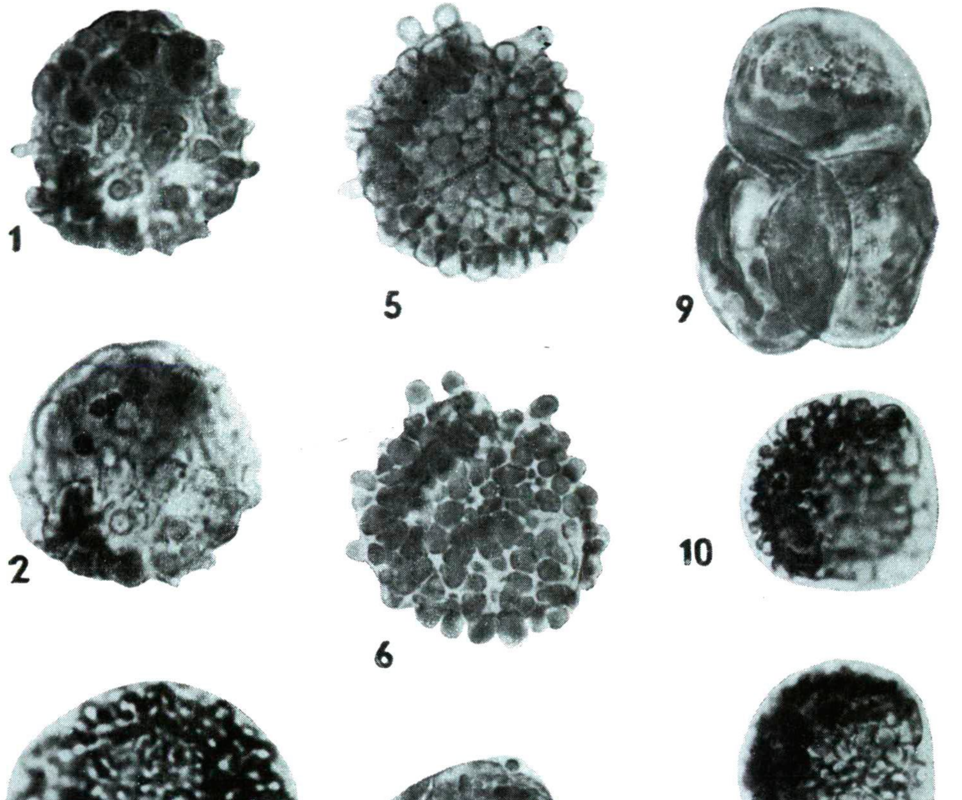
Holotypus: Plate IX., 1, 2, prep. U—III—2—121—5.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore mother-lode of the shaft III.

Plate IX.

1, 2. — *Clavatisporites platycapitulus* n. fgen. et fsp. (U—III—2—121—5)
3, 4. — *Clavatisporites platycapitulus* n. fgen. et n. fsp. (U—III—4—1, 9, 4)
5, 6. — *Clavatisporites pulcher* n. fgen. et fsp. (U—III—4—19)
7, 8. — *Clavatisporites microcapitulus* n. fgen. et fsp. (U—III—4—18)
9. — *Clavatisporites microcapitulus* n. fgen. et fsp. (U—III—4—25)
10, 11. — *Clavatisporites minor* n. fgen. et fsp. (U—III—6—1, 1, 5/74)
12. — *Clavatisporites* fsp. (U—III—2—1, 18/102, 5)
1000×

Plate IX.



Stratum typicum: Dark-grey, finely streaked clayey marl with manganese carbonate content.

Derivatio nominis: from the wide heads of the clavae.

3. *Clavatisporites pulcher* n. fsp. (Plate IX., 5, 6)

Diagnosis:

Seen from the pole the contour is a considerable rounded off triangle. The side lines of the spore are convex. The peaks are sometimes slightly pointed. At the proximale pole the surrounding of the tetrad mark is without any ornaments. Seen from the pole only surrounding of the equatorial contour is covered with clavae in a 4 μ wide zone. The laesures of the tetrad mark are straight, well developped and they reach almost the equatorial contour, $r={}^4/_5$. The distale pole is densely covered with ornamental elements. The heads of the clavae are globose, sometimes they are angularly pressed, their diameter is 1—4—5 μ, mostly 3,5 μ.

Maximal measurement 41 μ.

Holotypus: Plate IX., 5, 6, prep. U—III—4—19.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore motherlode of the shaft III.

Stratum typicum: Green, grey, finely streaked manganese ore with carbonate content.

Derivatio nominis: from the regular ornaments of the distale pole.

4. *Clavatisporites microcapitulus* n. fsp. (Plate IX, 7—9)

Diagnosis:

Seen from the pole the contour is circular. The exosporium is thin, it is always less than 1 μ. The clavae on the surface of the spore are sparsely dispersed. The haeds are 3 μ diameter in maximal measurement. The laesures of the tetrad mark are sometimes slightly wavy and do not always reach the equatorial contour, $r={}^4/_5$—${}^5/_5$.

Maximal measurement: 28 μ.

Holotypus: Plate IX., 7, 8, prep. U—III—4—18.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore motherlode of the shaft III.

Stratum typicum: Green, grey, finely streaked manganese ore with carbonate content.

Derivatio nominis: from the relative small heads of the ornamental elements.

5. *Clavatisporites minor* n. fsp. (Plate IX., 10, 11)

Diagnosis:

Seen from the pole the contour is rounded off. The thickness of the exosporium is 1 μ. The ornaments are 3 μ high, the heads of the clavae are 1—3 μ in diameter, the most frequently 2 μ. The laesures of the tetrad mark are straight and they reach almost the equatorial contour, $r={}^4/_5$.

Maximal measurement: 30 μ.

Holotypus: Plate IX., 10, 11, prep. U—III—6—1, 1, 5/74.

Locus typicus: Úrkút, manganese mine, carbonate manganese ore motherlode of the shaft III.

Stratum typicum: Green, grey, finely streaked manganese ore with carbonate content.

Derivatio nominis: from the small measure.

6. *Clavatisporites* fsp. (Plate IX., 12).

The heads of the sculpture elements are sometimes very large, maximal measure 6 μ. This characteristic distinguishes exactly this form-species, from the other ones. Sorry, the exemplares observed are very corroded and among others the characteristics of the laesures are not to be recognise. Therefore at present we can not give the exact description of this spores.

Fgen.: DICTYOTRILETES (NAUMOVA 1937) R. POT. and KR. 1954
Subfgen.: DICTYOTRILETES (KLUKISPORITES COUPER 1958) STANLEY and POCOCK 1962.

1. *D. (Klukisporites) deaki* n. fsp. (Plate X., 1, 2).
2. *D. (Klukisporites) variegatus* (COUPER 1958) n. comb. (Plate X., 3–6)

Notes. — These spores according to COUPER [1958] belong to the genus *Klukisporites* COUPER 1958. STANLEY and POCOCK [1962] however demonstrated that the genus *Klukisporites* COUPER 1958 is the synonym of *Dictyotriletes* (NAUMOVA 1937) R. POT. and KR. 1954. They publicated one spore fsp. of COUPER [1958] as *Dictyotriletes (Klukisporites) pseudoreticulatus* (COUPER) STANLEY and POCOCK 1962. So they removed as subform-genus from the form-genus *Dictyotriletes* (NAUMOVA 1937) R. POT. and KR. 1954 the spores which were similar to the spores prepared from Klukia megafossilia. This method is followed by us too. *Ischiosporites* BALME 1957 described by BALME [1957] is similar to or identical with this subform-genus.

BOLKHOVITINA [1961] arranged the genus *Klukia* RACIBORSKI 1890 into the familia *Schizaeaceae*. On the basis of the work of COUPER [1958] she published the *Klukisporites visiblis* (BOLKH.) BOLKH. — (syn.: *Stenozonotriletes visiblis* BOLKH. 1953). She denoted the stratigraphical distribution of the spores belonging to the form-genus *Klukisporites* COUPER as the Middle and Upper Jurassic and Lower Cretaceous period.

To this type belongs probably the spore published by KURNOSOVA (1960) from the Upper Jurassic layers of Krasnoyarsk named *Brochotriletes* NAUM. (Plate 5., 15).

1. *Dictyotriletes (Klukisporites) deaki* n. fsp. (Plate X., 1, 2)

Diagnosis:

Seen from the pole the contour is triangular with rounded off angles and convex side lines. The thickness of the exosprium extends to 2,5 μ. The ectexosporium is more thick than the endexosporium. Near to the tetrad mark the surface is smooth or finely scabrat. The laesures do not always reach the equatorial contour, $r = {}^4/_5 - {}^5/_5$. Maximal diameter of the area surrounded by the sculptural elements is about 10—14 μ. Seen from above the width of the sculptural elements is about 2,5 μ.

Maximal measurement: 58 μ.

Holotypus: Plate X., 1, 2, prep. U—III—3—1.

Locus typicus: Úrkút, manganes mine, carbonate manganese ore motherlode of the shaft III.

Stratum typicum: Green, grey, finely streaked manganese ore with carbonate content.

Derivatio nominis: from DR. M. H. DEÁK, the excellent investigator of Hungarian mesozoic sporomorphs.

Notes. — The measure of the sculptural elements and the structure of the reticulum distinguish it from *Dictyotriletes (Klukisporites) variegatus* (COUPER 1958) n. comb.

2. *Dictyotriletes (Klukisporites) variegatus* (COUPER 1958) n. comb. (Plate X., 3—6)

Seen from the pole the contour is triangular with rounded off angles and straight or convex slides. At the proximal pole the laesures of the tetrad mark reach almost the equator. Along the laesures there is a 3—4 μ wide torus. The average width of the exosporium is 3,8 μ, the ectexosporium is more thick, than the endexosporium. Seen from above the sculptural elements of the distale pole are 3—4 μ wide in average and they surround a 6—8 μ large irregularly formed area. The maximal measurement of the exemplares observed is 68—88 μ.

According to COUPER [1958] this spore is characteristic on the Middle Jurassic sediments. SAAD [1963] published it as *Klukisporites variegatus* COUPER from the Bajocian sediments of the Middle Jurassic period of Euone Moussa, (a district West of Sinai).

In connection with the spores previously discussed in detail the following summarized evaluation may be given:

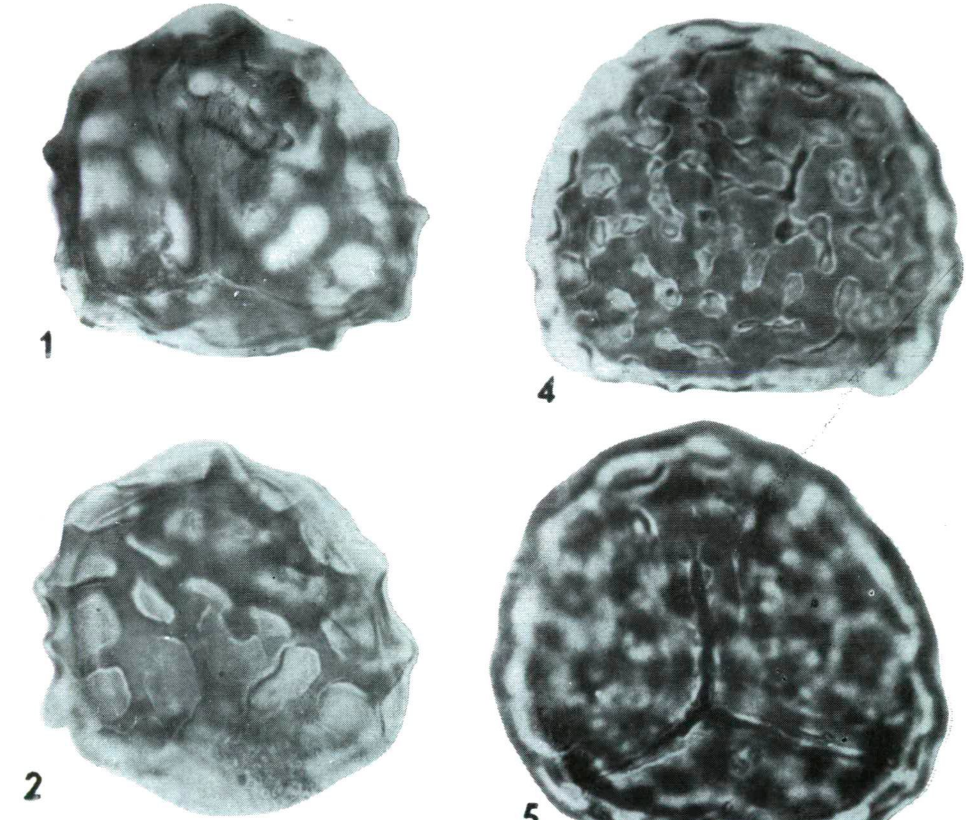
1. In this work 46 spores were discussed in detail. 1 new form-genus and 34 new form-species were described. As new combinations 5 form-species and other 6 form-species previously described were established. 1 spore type was not closer determined due to its incomplete morphology. In authors' previous works only 17 spore types were described and so this work considerably enriched the knowledge of the spore-pollen complex of the Hungarian Jurassic sediments.

2. In the course of the discussion of the taxa 58 forms of similar morphology were mentioned: 9 from the Triassic, 39 from the Jurassic, and 11 from the Cretaceous period. According to the data of the literature the basic type of the Jurassic spore-pollen complexes, known from the sediments of the same age of Eurasia (including the arctic area of the USSR), Ceylon, Pakistan, North-Africa, Egypt and Canada, are similar to each other in many properties. Consequently the Jurassic vegetation was also similar in the identical stages. Naturally, this similarity does not mean a complete identity of the species on these remote areas. There is a possibility, however, to parallelize the Jurassic sediments of remote areas with the aid of palynological methods. As the best

Plate X.

1, 2. — *Dictyotriletes (Klukisporites) deaki* n. fsp. (U—III—3—1)
3, 4. — *Dictyotriletes (Klukisporites) variegatus* (COUPER 1958) n. comb. (U—III—2—59)
5, 6. — *Dictyotriletes (Klukisporites) variegatus* (COUPER 1958) n. comb.
1000×

Plate X.



example may be mentioned the latest results of SAAD [1963] about the Jurassic spore-pollen complexes of Egypt.

3. According to authors' own investigations and the data of the literature, the most wide-spread spore types stratigraphically arranged are the followings:

A) In the sediments of the Triassic and the Lower Jurassic period a very frequent type is:

Toroisporis (Toroisporis) toralis (LESCHIK 1955) n. comb.

B) Characteristic in first line to the Jurassic sediments are:

Leiotriletes manganicus n. fsp.

Toroisporis (Toroisporis) curvitorus n. fsp.

Verrucosisporites rarus n. fsp.

C) In the Jurassic and Cretaceous periods frequent types are:

Leiotriletes sphagnoides n. fsp.

Concavisporites (Obtusisporis) kara-murzae n. fsp.

Clavatisporites n. fgen.

D) In the sediments of Triassic, Jurassic and Creataceous periods equally frequent types are:

Leiotriletes urkutensis n. fsp.

Punctatisporites rotundus n. fsp.

4. The data of the two previous points put the establishments about the age of the manganese ore mother-lode of Úrkút in a new light. The types occuring equally in the Triassic, Jurassic and Cretaceous periods are summarized in the followings:

Trias	Jura	Creta	
9	38	11	(all the literary data)
1	3	3	(especially wide-spread spore types)

These results do not support the Upper Liassic origin of the manganese carbonate ore mother-lode. On the basis of the abovementioned data it may be supposed more probably the origin from the Middle or Upper Jurassic period, because the types from the Cretaceous period are more numerous that the types from the Triassic period. This is not the final establishment of the authors. For this purpose it must first eveluate all of the new palynological data. On the basis of the data till now the manganese ore seems younger than the Upper Liassic period, most probably in the Bajocian stage. This establishment is supported by the palynological data of the hard coal from the Lower Liassic period of Komló. In connection with this the forms of similar types from Komló and Úrkút are to be mentioned. These forms are either of „older" types (e. g. *Toroisporis [Toroisporis] toralis* [LESCHIK 1955] n. comb.) or definitely Jurassic ones. On the other hand, it is very important, that BÓNA [1963] found the form species *Zebrasporites* KLAUS 1960 in the carboniferous Liassic layers of Komló, which form-genus was first described from layers of the Carnian stage. According to the investigations of SCHULZ [1962] in Thüringia the spores of this form genus are characteristic in the Rhätian-Liassic border, especially in the Rhätian stage, but they occur in the lowest layer of the Liassic period (Lias α_1) too. This also support the Lower Liassic origin of the hard coal of Komló. In addition to this, forms of more modern types

(e. g. *Dictyotriletes [Klukisporites] variegatus* [COUPER 1958] n. comb.) are lacking in the spore-pollen complexes of the carboniferous layers of Komló. So the two Liassic formation may be well distinguished on palynological basis. A detailed stratigraphical palynology of the Lower Liassic period of Komló and the presumed Upper Liassic period of Úrkút may be not yet given because of the lack of a complete modern palynological analysis of these complexes.

In connection with the quantitative results of the palynological investigations the followings are to be mentioned (Figure 1.):

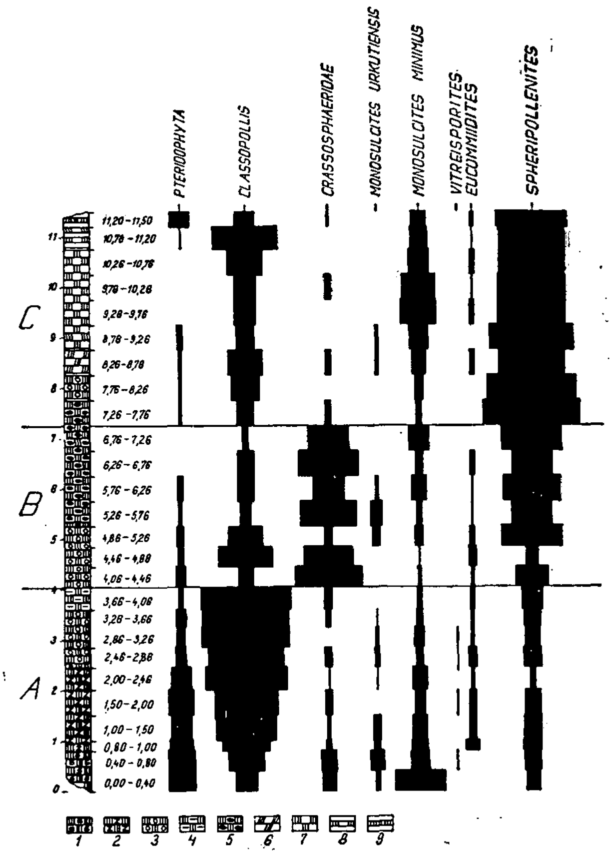


Figure 1.

Drawing of the profil investigated with the diagram of spores and pollens. A = *Classopollis-level*, B = *Crassosphaeridae-level*, C = *Spheripollenites-level*. 1 = dark grey, finely streaked clayey marl with manganese carbonate, 2 = green, grey, finely streaked carbonate manganese ore, 3 = brownish green, greenish brown, browns and finely streaked carbonate manganese ore, 4 = brown, light brown, finely streaked carbonate manganese ore, 5 = black, brownish black, light brown, finely streaked carbonate manganese ore, 6 = brownish red, locally roughly streaked carbonate manganese ore, 7 = green, greenish brown, light green, grey, roughly streaked carbonate manganese ore, 8 = grey, rhodochrozit and pyrit containing carbonate manganese ore, 9 = grey, radiolaria containing clayey marl with manganese containing streaks.

From the point of view of stratigraphical division of the profil of the manganese carbonate mother-lode the taxa *Classopollis* Pflug 1953, *Crassosphaeridae* and *Spheripollenites* Couper 1958 are of greatest importance. Further, it may be taken into consideration the total number of *Pteridophyta* spores and the changes of the quantity of *Monosulcites minimus* Cookson 1947. Some other taxa are also represented on the Figure (*Monosulcites urkutensis* Simoncsics and Kedves 1961, *Vitreisporites* fsp., *Eucommiidites* fsp.), but their stratigraphical significance is unimportant. The forms belonging to the form genus *Vitreisporites* are not to be considered as level-indicators, because of their sporadic occurrence in the lower third of the bed. A short characterization of the three levels of the carbonate manganese ore distinguished with the aid of palynological method is given as follows:

A) *Classopollis-level* (Figure 1. A)

It is characterized by the dominancy or high quantity of the pollens of the form genus *Classopollis* Pflug 1963 and the relative high per cent and form-abundance of *Pteridophyta* spores.

B) *Crassosphaeridae-level* (Figure 1. B)

It is fairly distinguished from the former level by the dominancy or at least high per cent of spores belonging to the different genera and species of the different genera and species of the familia *Crassosphaeridae*. The dominancy of the pollens of the form genus *Classopollis* come to an end and the quantity of the *Pteridophyta* spores diminishes to a minimum.

C) *Spheripollenites-level* (Figure 1. C)

The pollens of the form species of the form genus *Spheripollenites* are dominant. *Monosulcites minimus* Cookson 1947 and *Classopollis* Pflug 1953 occur locally in higher per cent. Occurrence of *Crassospaeridae* is sporadic.

The possibility of the reconstruction of the levels characterized above i. e. the practical use is proved by the possibility of the parallelization with the spore complexes established in the course of former investigations of the authors [1961] on the manganese ore of Úrkút. The following palynological characteristics are to be emphasized in connection with the samples 33 „a" and 35 „b", which are also accessible to a quantitative evaluation:

1. The dominancy of the pollens belonging to the form-genus *Spheripollenites*.

2. The comparatively high quantity of *Monosulcites minimus* Cookson 1947, in the lower sample 35 "b" with a relatively high content of the pollens *Classopollis*.

3. Few *Pteridophyta* spores.

4. Quantity of *Crassosphaeridae* is minimal. It is not represented on the diagram, it is mentioned only among the qualitative results.

These palynological characteristics are identical with the „C", *Spheripollenites* level of the fundamental profil. Taking into consideration the regular changes of quantity of *Monosulcites minimus* Cookson 1947 inside the "C"-level, the samples 33 "a" and 35 "b" mentioned above may be identified more exactly with the middle part of the upper, "C"-level. According to this the idea arises, that inside the three level established, further sublevels might be distinguished. e. g. In the case of the level "C" three sublevels may be distinguished and similar possibilities may be supposed in the case of the other levels. This further distinctions, however, are considered by the authors as unnecessary, all the more because it is uncertain, that the identification of the sublevels will be so easy in all cases as in this one.

As shown above, the levels of the carbonate manganese ore were established on palynological basis with the aid of two factors:

1. The autochtonous microplanctontic organisms *(Crassosphaeridae).*
2. The accumulation of autochtonous and allachtonous sporomorphs in the sediments. These latters presented themselves in different composition in the course of the cycle of immersion parallel with the different vegetation types surrounding the basin in which the sediments accumulated. So the basis for the establishment of the levels of the manganese ore were the changes of the biotops and vegetation surrounding the basin. In the course of the formation of the carbonate manganese mother-lode of Úrkút the zonation of the surrounding vegetation may be reconstructed as follows (Figure 2.):

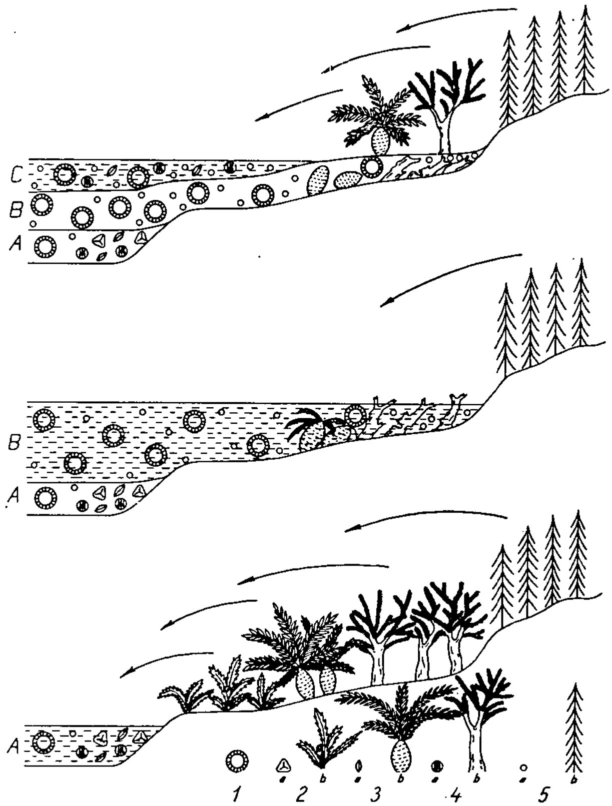


Figure 2.

Schematic reconstruction of the vegetation surrounding the basin in which the manganeous sediments accumulated and the development of the spore-pollen complexes of each levels. 1 = *Crassosphaeridae,* 2 = *Filicinae;* a: spore, b: fern plant, 3 = *Cycadinae;* a: pollen, b: grawn-up plant, 4 = *Classopollis* producing *Coniferae,* a: *Classopollis,* b: *Classopollis* producing plant, 5 = *Spheripollenites* producing *Coniferae,* a: *Spheripollenites,* b: *Spheripollenites* producing plant.

The spore and pollen composition of the level "A" indicates the vicinity of open water vegetation. This is proved by the presence of *Crassosphaeridae* relics. Next to the shores on humid biotops the great quantity of *Filicinae* spores indicates an association with ferns. More remoted followed a level with *Cycadinae* and *Coniferae.* The latters produced the pollens belonging to the form-genus *Classopollis.* The botanical connections of this pollen type are discussed in detail by POCOCK and JANSONIUS [1961]. Their establishments are accepted by the authors too. According to this the plants producing the pollens of *Classopollis* type were extinct *Gymnospermae.* Also some species of *Cheirolepis, Brachyphyllum* and *Pagiophyllum* produced pollens of such a type. One considers these plants as *Coniferae* which lived along the shores but in arid biotops. They lived in the vicinity of fossil *Cycadinae.* Accordingly the *Filicinae* zone was followed by a coenosis containing *Cycadinae, Cheirolepis, Brachyphyllum* and *Pagiophyllum.* According to this reconstruction the process of inundation of the biotops with an arider ecology inside the level "A" may be well explained. The per cent proportion of the pollens belonging to the form-genus *Classopollis* increases and it reaches a maximum in the uppermost part of the level. This is explained by the supposition, that the quickly rising water destroyed the *Filicinae* zone and reached directly the *Classopollis* producing *Coniferae* zone. This process is indicated by the regular changes in the quantity of the *Filicinae* and *Classopollis* pollens. Due to the inundation of the biotop of the *Classopollis* producing *Coniferae* and the destruction of the vegetation, the spores accumulated in the sediments originated already not from the litoral vegetation but they were produced by planctontic organism *(Crassosphaeridae,* level B) and by *Coniferae* living in higher biotops *(Spheripollenites).* This supposition, i. e. between the biotops of the *Coniferae* producing *Classopollis* and *Spheripollenites* respectively it existed a very considerable ecological difference, is the only acceptable explanation of the sharp palynological border between the levels "A" and "B" and "B" and "C". The *Classopollis* minimum following a *Classopollis* maximum mey be explained only with the supposition that the rising water reached a *Coniferae* zone living on a plain area. At this time accumulated the *Classopollis* pollen in a maximal quantity. After the inundation of the area this vegetation was destructed. So the maximum of the *Classopollis* accumulation diminished to a minimum. Parallel with this the planctontic organism appeared at once in dominant or at least in a very considerable quantity and besides the pollens of plants living on higher biotops *(Spheripollenites)* accumulated in the basin. In the level "B", which may be considered as a devastation level, the situation made possible the fossilization of the stems in the manganese ore layers. In connection with this two related problems are to be mentioned:

1. The botanical connections of the silicified stems.

2. The problem, wether the *Classopollis* producing plants *(Cheirolepis, Brachyphyllum* and *Pagiophyllum)* belong to the *Araucariaceae* or not. The stems from the manganese ore of Úrkút (first investigated by ANDREÁNSZKY [1949]) have an araucaroid structure. In contrast to this ANDREÁNSZKY did not deduced the conclusion (which seems perhaps a logical one), that these stems are in a direct evolutionary connection with the modern Araucariaceae. (Namely, a great part of the mezozoic stems and almost all paleozoic ones are of araucaroid structure.) These stems must be the plants which produced

Classopollis: Cheirolepis, Brachyphyllum and *Pagiophyllum.* This is the opinion of POCOCK and JANSONIUS [1961] too.

On the other hand COUPER [1958] brought the in situ found pollens of *Pagiophyllum connivens* KENDALL and *Cheirolepis münsteri* SCHENK in connection with *Classopollis torosus* (REISSINGER) COUPER on a morphological basis. In contrast to KENDALL as belonging to *Araucariaceae* because of the totally different morphology of the in stiu pollens and the pollens of the recent *Araucariaceae.* The xylem structure of the stems investigated by KENDALL [1952] indicates a relation with the *Araucariaceae.* This property, however, is not a conclusive proof, according to the abovementioned facts. The *Classopollis* type pollen of *Pagiophyllum connivens* KENDALL is inconsistent with the *Araucariaceae* and therefore authors agree with POCOCK and JANSONIUS [1961]. The formation of the level "C", however, might be a shallow moore. The conditions corresponding to the ecological demans of the *Classopollis* producing *Coniferae* are not yet developped. In the sediments accumulated henceforward the pollens of the *Coniferae* living on higher areas *(Spheripollenites).* The rising of the quantity of the *Pteridophyta* spores and *Classopollis* in the upper part of the level indicates the re-establishment of the original ecological conditions.

Summarizing the ideas about the zonation of the vegetation surrounding the basin in which the sediments accumulated, the following coenoses were established:

1. An open vegetation far off the shores with planctontic algae.
2. A *Pteridophyta* coenosis with humid ecology along the shores.
3. A *Coniferae* coenosis with *Cycadinae—Cheirolepis—Brachyphyllum—Pagiophyllum* near the shores with an arid ecology.
4. The *Spheripollites* producing *Coniferae* coenosis which lived on the higher areas.

In the course of the sediment formation authors consider the *Crassosphaeridae* as autochtons, the spores of *Pteridophyta* and the pollens of the form-genera *Classopollis* and *Monosulcites minimus* COOKSON 1947 as sedimental autochtons, because these plants formed the vegetation of the shores and the area near to the shores of the basin. The *Spheripollenites* pollens were considered as allochtons, because the plants producing these pollens lived undoubtedly on higher areas beyond the basin. The proof for this is the following: the per cent values of *Crassosphaeridae* and *Spheripollenites* in the level "B" give a sum which is essentially identical with the quantity of *Spheripollenites* in the level "C", i. e. there is no difference between the levels "B" and "C" considering the pollens occuring in maximal quantity. The sharp border betweeen the two levels may be indicated by the diminishing to a minimum of the autochtonous marine planctontic residues.

SUMMARY

1. Authors' latest investigations on the carbonate manganese mother-lode of Úrkút demonstrated, that in the carbonate ores there are more sporomorphs than in the oxid ores. The qualitative and quantitative data are suitable not only for the determination of the age of the ore but for microstratigraphical purposes too.

2. From the sporomorphs demonstrated in this work 46 spores were discussed in detail. 1 n. fgen., 34 n. fsp. and 5 n. comb. were described. 1 spore type was not closer determined due to the insufficient morphology.

3. On the basis of the qualitative results as the age of the formation of the manganese ore investigated seems younger than the Upper Liassic period.

4. On the fundamental profil of the carbonate manganese ore mother-lode of the shaft III. of Úrkút the levels were distinguished on palynological basis:

A) *Classopollis-level.*

B) *Crassosphaeridae-level.*

C) *Spheripollenites-level.*

5. Suitability these levels for identification of layers was proved by parallelization of the diagram of the fundamental profil with the quantitative data previously published by the authors.

6. Establishment of layers in the manganese ore on a palynological basis was attributed to the zonation of the vegetation surrounding the basin in which the sediments accumulated and to the changes in the microfossilia composition caused by the changes of the vegetation in the time of the formation of the sediments.

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